

900-TC Temperature Control Device Building Block

Connected Components Accelerator Toolkit



Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.



WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.



ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.

IMPORTANT

Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.



SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.



BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

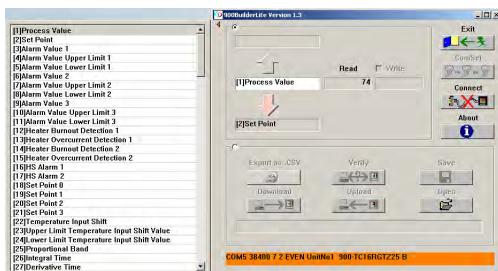


ARC FLASH HAZARD: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

Follow this path to complete your Connected Components Accelerator Toolkit (CCAT) project.

Read the Getting Started CCAT with
System Design Assistant Quick Start,
publication [CC-QS035](#).

Chapter 1 - 900-TC Temperature Controller Setup



Chapter 2 - Validate Your System



Notes:

Preface

About This Publication.....	7
Terminology	8
Available Connected Components Accelerator Toolkits	9
Additional Resources.....	9

Chapter 1

**900-TC Temperature
Controller Setup**

Before You Begin	11
What You Need	11
Follow These Steps.....	12
Review 900-TC16 Front Display Operation.....	13
Choose a Communication Port	14
Set Communication Parameters	14
Set Communication Writing.....	14
Change Communication Parameters for Modbus Protocol	15
Set the Parameters Used in This Building Block Application.....	16
Set the 900-TC Temperature Controller for Manual Control.....	17
Change the Initial Setting/Communication Protection Parameter	17
Change the Auto/Manual Select Addition Parameter	17
Set Parameters with 900Builder Lite Software and 900-CPOEM1	
Cable (optional)	18
Install the 900Builder Lite Software and the USB Driver	18
Set the 900-TC16 Controller Parameters By Using the Software and Cable.....	19
Set the Parameters Used in This Building Block Application	24
Upload and Save Your Settings.....	24
Download Your File to Another 900-TC Temperature Controller (optional)	26
Review Other Possible Parameters.....	28

Validate Your System	Chapter 2
	Before You Begin..... 31
	What You Need..... 31
	Follow These Steps..... 32
	Review the System Overview..... 33
	Configure the Controller Communication Ports..... 34
	Configure PanelView 800 Terminal Communication Settings..... 38
	Connect Your Devices..... 40
	Download Your Program to the Controller..... 40
	Configure the IP Address for Your PanelView 800 Terminal..... 42
	Transfer Your HMI Application to the PanelView 800 Terminal.... 43
	Validate Your System..... 45
	Understand the Machine Functions Screen..... 45
	Understand the Status and Command Screen..... 46
	Verify Manual Operation of the 900-TC Temperature Controller . 48
900-TC Temperature Controller User-defined Function Blocks	Appendix A
	RA_TC_MBUS_STS User-defined Function Block..... 51
	RA_TC_MBUS_CMD UDFB..... 54
Global Variables	Appendix B
 57

About This Publication

This quick start provides instructions for implementing a 900-TC temperature controller application on Modbus by using the Connected Components Workbench™ software and a Micro800® programmable logic controller (PLC).

To help with the design and installation of your system, application files and other information are provided on the Connected Components Accelerator Toolkit (CCAT). The CCAT provides bills of materials (BOM), CAD drawings for panel layout and wiring, control programs, human machine interface (HMI) screens, and more. With these tools and the built-in best-practices design, you are free to focus on the design of your machine control and not on design overhead tasks.

The CCAT is available on the Connected Components Accelerator Toolkit DVD, publication CC-QR002, or through the Rockwell Automation® Software Download and Registration System (SDRS) site at

<http://www.rockwellautomation.com/rockwellautomation/products-technologies/connected-components/tools/accelerator-toolkit.page>.

The beginning of each chapter contains the following information. Read these sections carefully before you begin work in each chapter:

- **Before You Begin** - The chapters in this quick start do not have to be completed in the order in which they appear. However, this section defines the minimum amount of preparation that is required before completing the current chapter.
- **What You Need** - This section lists the tools that are required to complete the steps in the current chapter, including, but not limited to, hardware and software.
- **Follow These Steps** - This section illustrates the steps in the current chapter and identifies the steps that are required to complete the examples.

Terminology

Term (abbreviation)	Definition
Application Sequence Programs	User-modified programs that work together with the standard state machine logic to control what the machine does while in the abort, clear, reset, run, and stop states.
Auto/manual operation	When the PanelView™ 800 terminal is in Auto mode, the controller logic controls the machine and monitors machine status. When the PanelView 800 terminal switches to Manual mode, the terminal takes over control. Command buttons and numeric entry fields are available only when the machine is in Manual mode.
Bill of Materials (BOM)	A list of components that are needed for your system.
Building block (BB)	Tools to accelerate and simplify the development of a Micro800 controller-based application. A typical building block includes a starting Bill of Material (BOM), Computer-Aided Design (CAD) drawings, Micro800 controller programs, PanelView 800 terminal applications, and a quick start document.
Computer-Aided Design (CAD)	A computer-based system that is developed to facilitate design of mechanical parts.
Connected Components Accelerator Toolkit (CCAT)	Software with application files and other information to speed the design and startup of component-based machines.
CCAT project	A project that consists of these items: <ul style="list-style-type: none"> • A ProposalWorks™-based bill of materials • A set of CAD drawings (dimensions and schematics) • A Connected Components Workbench project • HMI screens • A set of Quick Start documents • A project document with information about the project components and links to reference materials
Connected Components Workbench™ software	Software environment to configure or program Micro800 controllers, PanelView 800 terminals, PowerFlex® drives, and other component-level products.
Connected Components Workbench project	A project that consists of one or more of these items: <ul style="list-style-type: none"> • Micro800 controller configuration • Up to 256 Micro800 programs, each with program local variables • Micro800 global variables • PanelView 800 terminal application • PowerFlex drive parameter lists
Global variables	Project variables that any program can access, which includes all I/O and system variables.
State Machine control code	Machine logic to coordinate overall machine operation that is based on states. The state machine broadcasts commands and receives feedback information from each of the building blocks via user-modified application sequence programs.
Tags	A PanelView 800 term for variables.
User-defined Function Blocks (UDFBs)	Function block instructions that can be used like standard function block instructions within any Connected Components Workbench programming language. Anyone who uses Connected Components Workbench software can write these functions blocks. Many UDFBs are posted on the Rockwell Automation sample code website: http://samplecode.rockwellautomation.com/idc/groups/public/documents/webassets/sc_home_page.hcst .
User-defined Object (UDO)	A collection of PanelView 800 terminal screen objects that can be pasted into a new screen.

Available Connected Components Accelerator Toolkits

For the most up-to-date listing of available Connected Components Accelerator Toolkits and related quick starts, refer to these resources:

- Rockwell Automation Connected Components Accelerator Toolkit website at <http://www.rockwellautomation.com/rockwellautomation/products-technologies/connected-components/tools/accelerator-toolkit.page>
- Connected Components Accelerator Toolkit Building Block Project Descriptions Quick Reference, publication [CC-QR003](#)

Additional Resources

These resources contain information about related products from Rockwell Automation.

Resource	Description
Micro800 Digital and Analog Plug-in Modules and Accessories User Manual, publication 2080-UM004	Provides information to install, wire, and troubleshoot Micro800 plug-in modules and accessories.
Micro820™ 20-point Programmable Controllers User Manual, publication 2080-UM005	Provides a reference guide for Micro820 controller systems. It also contains procedures to install, wire, and troubleshoot your controller.
Micro830® and Micro850® Programmable Controllers User Manual, publication 2080-UM002	Provides a reference guide for Micro830 and 850 controller systems. It also contains procedures to install, wire, and troubleshoot your controller.
PanelView 800 HMI Terminals Installation Instructions, publication 2711R-IN001	Provides information to install, wire, ground, and troubleshoot PanelView 800 HMI terminals.
PanelView 800 HMI Terminals User Manual, publication 2711R-UM001	Provides information to configure, operate, and troubleshoot the PanelView 800 HMI terminals.
Digital Temperature Controllers, Series B: Bulletin 900-TC8 and -TC16, publication 900-UM007D	Provides basic information to install, start up, and troubleshoot the 900-TC temperature control module.

You can view or download publications at <http://www.rockwellautomation.com/literature>. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Notes:

900-TC Temperature Controller Setup

This chapter guides you through configuring your 900-TC temperature controller to properly communicate by using Modbus RTU protocol and to function with a Micro800 controller programmed to use the sample building-block code supplied in this Connected Components Accelerator Toolkit (CCAT). Micro850 controllers are referenced throughout this Quick Start. Wherever a Micro850 controller is referenced, a Micro820 or Micro830 controller can be used. The procedure is very similar for the 900-TC8 controller.

In addition, this chapter specifies the minimum number of parameters that need to be changed from the factory default settings to establish communication with Micro800 controllers. For your machine application, there can be additional temperature controller parameters that need to be adjusted. Consult the temperature controller documentation listed in the [Additional Resources on page 9](#) for information on all of the other temperature parameters. This building block helps you develop an application to control a light, heater, relay, contactor (single or three-phase output), or fan by using an analog output from the 900-TC temperature controller.

Before You Begin

- Review the Getting Started CCAT with System Design Assistant Quick Start, publication [CC-QS035](#).
- Apply power to your 900-TC temperature controller.

What You Need

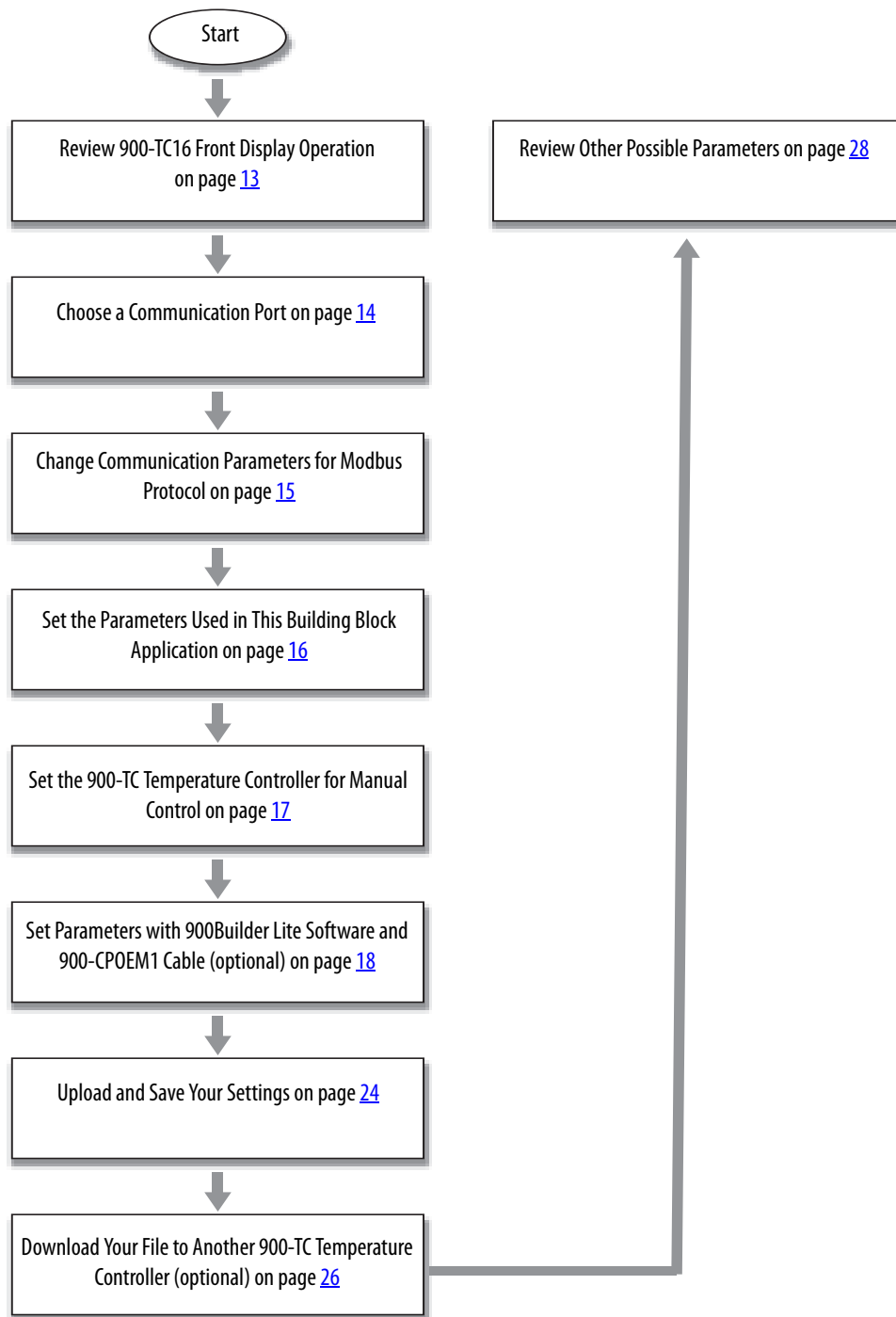
- Personal computer with 900Builder™ Lite software, version 3.0, loaded (optional)
- 900-CPOEM1 USB-serial conversion cable (optional)

IMPORTANT	You can program the 900-TC temperature controller by using the controller front display or the 900Builder Lite software. If you choose the latter, then you need a USB-serial conversion cable.
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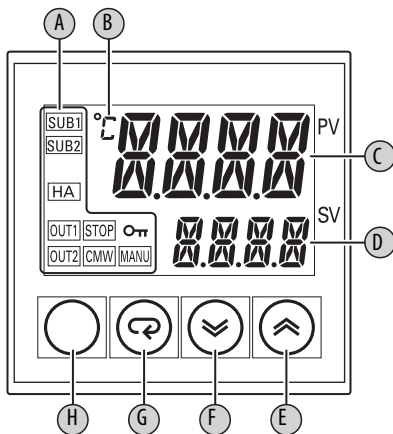
- Allen-Bradley 900-TC16 temperature controller or equivalent

Follow These Steps

Follow these steps to configure the parameters in the 900-TC temperature controller.



Review 900-TC16 Front Display Operation



Item	Operation Indicators	
A	SUB1	Illuminates red when the auxiliary 1 output is ON.
	SUB2	Illuminates red when the auxiliary 2 output is ON.
	HA	Illuminates red when a heater failure is detected due to open or short-circuit. The heater burnout alarm remains ON because the heater burnout latch is set. To reset, cycle the power supply or set the heater burnout alarm value to 0.0 A.
	OUT1	Illuminates amber when control output 1 is ON.
	OUT2	Illuminates amber when control output 2 is ON.
	STOP	Illuminates amber when control of the 900-TC16 controller has stopped. During control, this indicator lights when an event or the run/stop function has stopped. Otherwise, it is OFF.
	CMW	Illuminates amber when communication writing is enabled and is OFF when communication writing is disabled.
	MANU	Illuminates amber when the controller mode is Manual.
		Illuminates amber when the settings change protection is ON (and keys are disabled).
B	Temperature Unit	Temperature units are displayed when the display unit parameter is configured for temperature. When this parameter is set to °C, 'C' is displayed. When this parameter is set to °F, 'F' is displayed.
C	No. 1 Display	Displays the process value or parameter type (programmable as red, green, or amber).
D	No. 2 Display	Displays the set point, manipulated variable, or configured value (setup) of the parameter.
E	Up Key	Each press of this key increases values displayed in the No. 2 display. Holding down this key continuously increases values.
F	Down Key	Each press of this key decreases values displayed on the No. 2 display. Holding down this key continuously decreases values.
G	Mode Key	Press this key to select parameters within each functional group.
H	Function Group Selection Key	Press this key to select the set-up function group. The set-up function group is selected in this order: <ul style="list-style-type: none"> • Operation function group • Adjustment function group • Initial Setting function group • Communications Setting function group
G + H	Mode + Function Group Keys	This key combination sets the 900-TC16 controller to the Protect function group.

Choose a Communication Port

The 900-TC temperature controller has two communication ports that operate independently:

- Unit No. 1 – a fixed 4-pin port
- Unit No. 00...99 – an RS-485 port on 900-TC16 controllers and an RS-232C port on 900-TC8 controllers

TIP An RS-485 communication card must be installed in the controller to use RS-485 communication.

The communication parameters of the 900-TC16 controller must be set before any communication via Modbus protocol can be established. You can set the parameters with the front panel of the temperature controller or by using the optional 900Builder Lite software, version 3.0, and the 900-CPOEM1 cable.

TIP The easiest way to set parameters in an application that includes multiple 900-TC temperature controllers is to use 900Builder Lite software, version 3.0, and the 900-CPOEM1 cable.







Set Communication Parameters

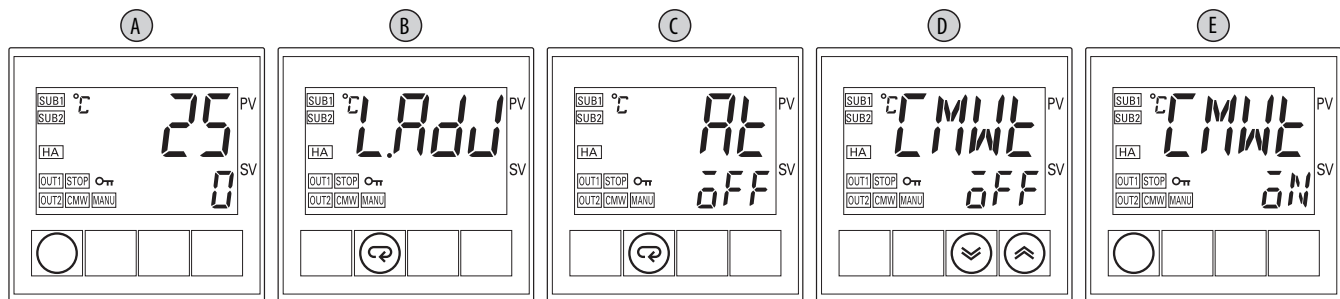
You must configure the temperature controller for Modbus communication so you can communicate between the PanelView 800 terminal, Micro800 controller, and 900-TC temperature controller.


This section provides instructions on how to manually set the communication parameters through the front panel of the temperature controller or by using the optional 900Builder Lite software, version 3.0, and the 900-CPOEM1 cable.

Set Communication Writing

Follow these steps to set the communication writing parameter to ON (OFF is default).

1. Press the  key for less than one second to access the Adjustment function group display (B).
2. Press the  key once to access the Autotuning (AT) parameter (C).
3. Press the  key once to access the Communications Writing enable/disable parameter (D).
4. Press the  or  key to set the communication writing parameter to ON (E).
5. Press and hold the  key for longer than one second to enable the change and to return to the Operation function group display (A).








When communication writing is enabled (ON), the  indicator on the front panel illuminates.

Change Communication Parameters for Modbus Protocol

The 900-TC temperature controller's communication parameters are set at the communication setting level.

Parameters	Characters Displayed	Range (bold text is default setting)
Communication protocol	<i>PSEL</i>	CWF /Mod
Communication unit number	<i>U-Nb</i>	0...99 (1)
Communication (baud) rate	<i>bPS</i>	1.2/2.4/4.8/ 9.6 /19.2/38.4/57.6 kps
Communication data length	<i>LEN</i>	7 /8 bit
Communication stop bit	<i>SBt</i>	1 /2
Communication parity	<i>PRty</i>	None /Even/Odd
Send data wait time	<i>SDWT</i>	0...99 ms (20)


Follow these steps to set these parameters manually.

1. Press and hold the  key for at least three seconds to move from the Operation function group display to the Initial Setting function group display.
2. Press the  key for less than one second to move from the Initial Setting function group display to the Communications Setting function group display.
3. Press the  key to select the appropriate parameters.
4. Use the  and  keys to change the parameter set values.

For Modbus protocol as used in this application, change to the following settings.

Parameters	Setting
Communication protocol	<i>Mod</i>
Communication unit number	1 ⁽¹⁾
Communication (baud) rate	19.2 kps
Communication parity	<i>NONE</i>









(1) This parameter sets a unique unit number for each temperature controller, letting the host identify the temperature controller during communication. One (1) is the default unit number. When two or more temperature controllers are used, do not use the same unit number.

5. Press the  key for longer than one second to enable your changed communication parameters.


Set the Parameters Used in This Building Block Application

Follow these steps to manually change parameters for this application.










Parameter	Description	Default Settings	Settings for This Application
	Set point	0	80
$\overline{I}n-t$	Input type	5	7 (J-type thermocouple)
$d-U$	Temperature unit	°C (Celsius)	°F (Fahrenheit)
$\overline{I}N\overline{I}L$	PID—On/off	$\overline{O}N\overline{O}F$ (On/off)	$\overline{P}ID$ (PID)
$\overline{O}R\overline{E}V$	Direct—reverse operation	$\overline{O}R\overline{E}V$ (reverse)	$\overline{O}R-d$ (direct)
$\overline{A}L\overline{t}1$	Alarm 1 type	2	8 (absolute value, upper limit)
$\overline{A}L\overline{t}2$	Alarm 2 type	2	8 (absolute value, upper limit)
$\overline{A}L-1$	Alarm value 1	0	75
$\overline{A}L-2$	Alarm value 2	0	85

1. Press and hold the  key for at least three seconds to move from the Operation function group display to the Initial Setting function group display.
2. Change the $\overline{I}n-t$ by using the  and  keys to set the input type to 7 or to match your input type.
3. Press the  key to move to the $d-U$ setting.
4. Press  to change from °C to °F.
5. Press the  key to move to the $\overline{I}N\overline{I}L$ setting.
6. Press the  key to change from $\overline{O}N\overline{O}F$ to $\overline{P}ID$.
7. Press the  key to move to the $\overline{O}R\overline{E}V$ setting.

IMPORTANT Perform step 8 only if you are using a fan.

8. Press the  key to change from $\overline{O}R\overline{E}V$ to $\overline{O}R-d$ operation.

TIP Direct ($\overline{O}R-d$) is typically used for fans and reverse ($\overline{O}R\overline{E}V$) is typically used for heaters.

9. Press the  key to move to the $\overline{A}L\overline{t}1$ setting.
10. Press the  key to change the setting to 8 or to the value you require for your application.
11. Press the  key to move to the $\overline{A}L\overline{t}2$ setting.
12. Press the  key to change the setting to 8 or to the value you require for your application.
13. Press and hold the  key for one second to return to the Operation function group display.
14. Press the  key to move to the $\overline{A}L-1$ setting.
15. Press the  key to change the level to 75 or the value you require for your application.
16. Press the  key to move to the $\overline{A}L-2$ setting.
17. Press the  key to change the level to 85 or the value you require for your application.







Set the 900-TC Temperature Controller for Manual Control

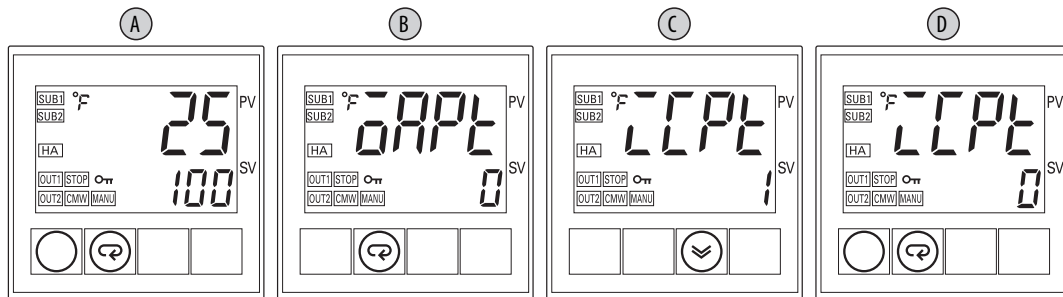
You can set the 900-TC temperature controller for manual control by using the front panel of the controller or by using the optional 900Builder Lite software.

The next section details how to change the communication parameters, which must be done before manual control can be set.

Change the Initial Setting/Communication Protection Parameter







To access the Advanced Setting function group, you must first change the Initial Setting/Communication Protection parameter by following these steps.



1. Press and hold the  and  keys simultaneously for at least three seconds to move from the Operation function group display (A) to the Protect function group, where Operation/Adjustment Protection is displayed (B).
2. Press the  key once to access the Initial Setting/Communication Protection display (C).
3. Press the  key to change the value from 1 (default) to 0.
4. Press the  and  keys simultaneously for at least one second (D) to return to the Operation function group display (A).

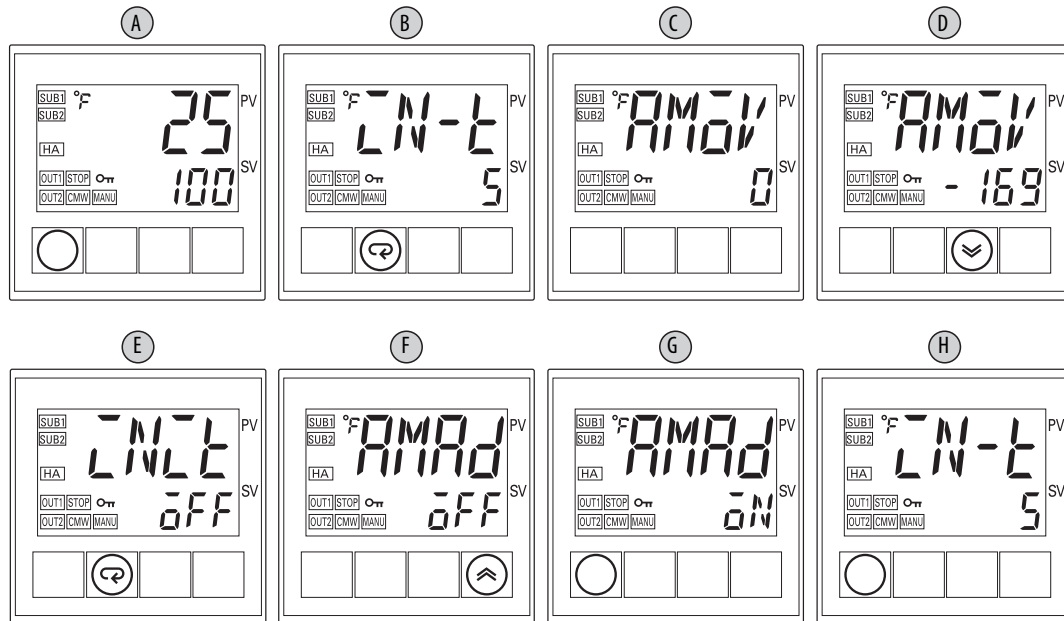


Change the Auto/Manual Select Addition Parameter

Follow these steps to configure the controller for manual control.

1. Press and hold the  key for at least three seconds to move from the Operation function group display (A) to the Initial Setting function group display (B).
2. Press the  key until you access the Move to Advanced Setting function group display (C).
3. Press the  key to display the password -169 (D).
4. Press the  key once to access the Advanced Setting function group display (E).
5. Press the  key until the Auto/Manual Select Addition display is visible (F).
6. Press the  key once to change the parameter from OFF (default) to ON.

7. Press the  key for at least one second to move from the Advanced Setting function group display (G) to the Initial Setting function display (H).
8. Press the  key for at least one second to move from the Initial Setting function group display (H) to the Operation function group display (A).



Set Parameters with 900Builder Lite Software and 900-CP0EM1 Cable (optional)

Use the 900Builder Lite software, version 3.0, to configure the temperature controller parameters.

IMPORTANT The 900Builder Lite software, version 3.0, supports the 900-TC8 Series B, 900-TC16 Series B, and 900-TC32 Series B temperature controllers.

Install the 900Builder Lite Software and the USB Driver

Follow these steps to install the 900Builder Lite software on your personal computer.

1. Double-click the Set-up icon or double-click the 'run setup.exe' file.

Full instructions for set-up options are available during the set-up process.

TIP Administrator privilege is required to perform 900Builder Lite software installation.

2. As part of the installation, choose a location for where to place the 900Builder Lite software icon.

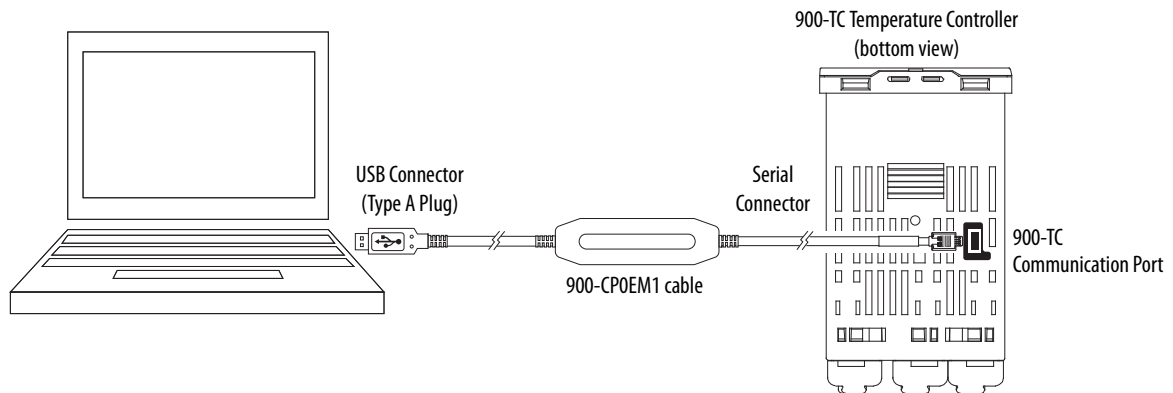
TIP After the installation, you can also choose Start > Programs > Rockwell Automation > 900Builder Lite to view the 900Builder Lite software icon.

To install the USB driver on your personal computer, follow the directions in the Bulletin 900 Direct USB to Temperature/Process Controller Configuration Cable Installation Instructions, publication [900-IN026](#).

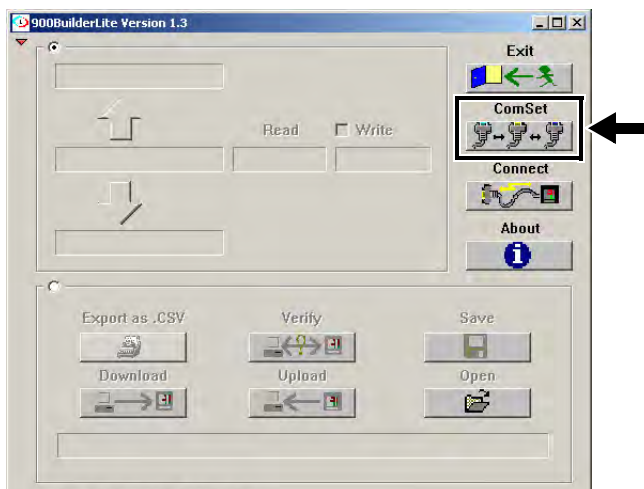
Set the 900-TC16 Controller Parameters By Using the Software and Cable

Follow these steps to set communication parameters for the 900-TC16 controller when using the 900-CPOEM1 cable.

1. Connect the 900-CPOEM1 cable to your personal computer's USB port and the 900-TC16 controller's communication port for support software.



2. Access and launch the 900Builder Lite software, version 3.0, as detailed in [Install the 900Builder Lite Software and the USB Driver](#) on [page 18](#).
3. In the 900Builder Lite main dialog box, click ComSet to open the Communication Settings dialog box.

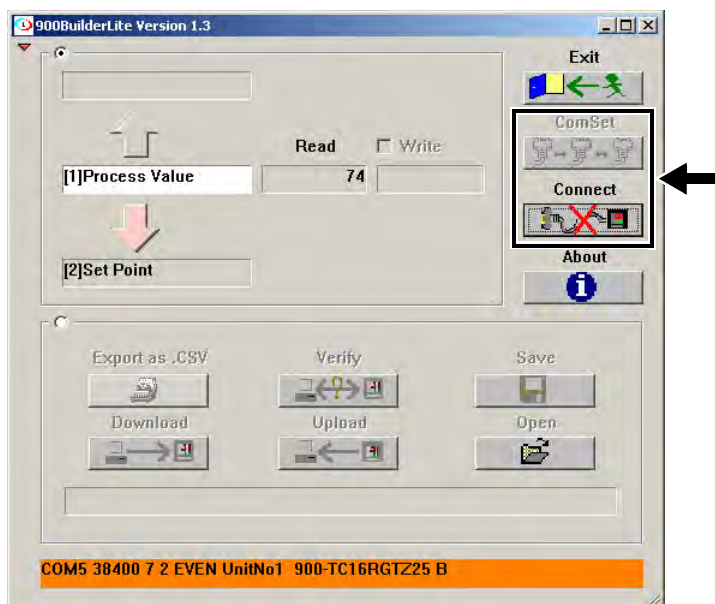
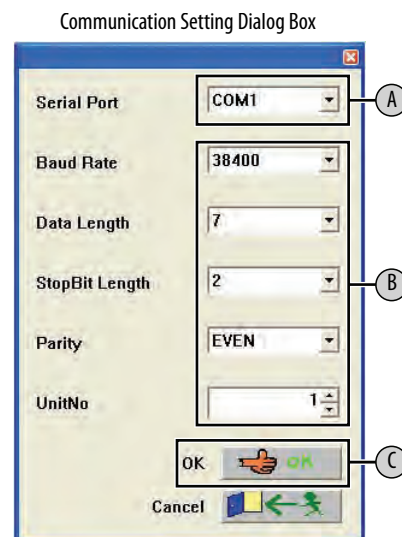


4. From the Serial Port pull-down menu, choose your personal computer's serial port (A).

The serial port of your computer can differ from the example at right.

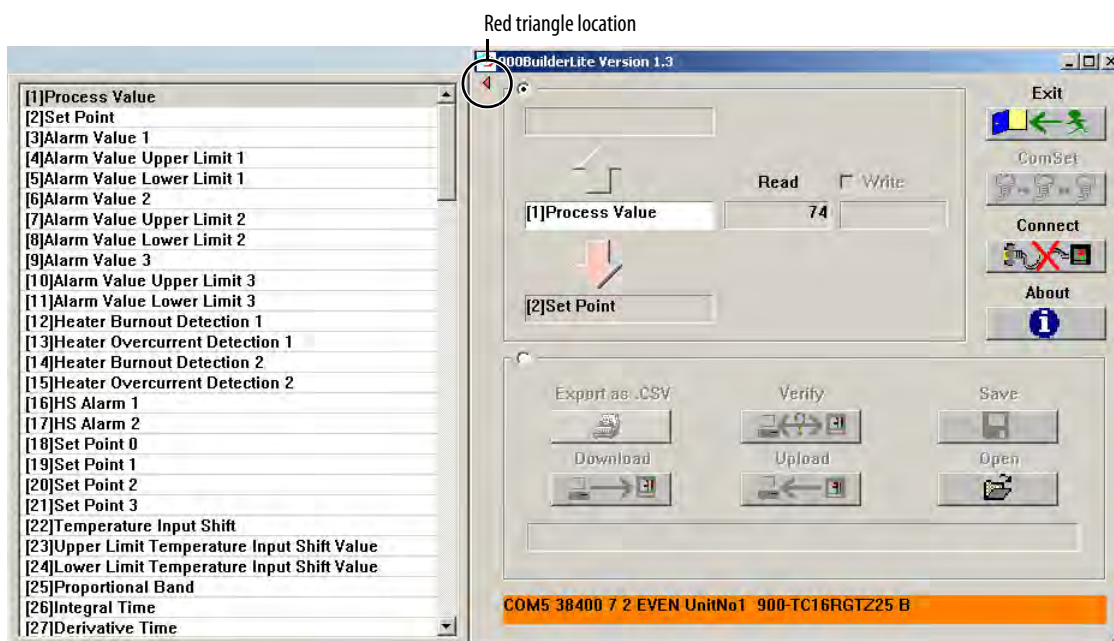
5. From each pull-down menu, choose the Baud Rate, Data Length, StopBit Length, Parity and UnitNo to match the numbers shown at right (B).
6. Click OK (C) to accept the changes and close the Communication Setting dialog box.
7. In the Main dialog box, click Connect.

The ComSet button becomes unavailable and the Connect is covered by a red X.

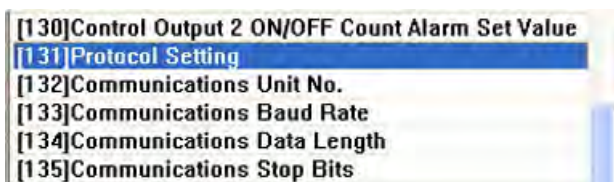


The model number of your temperature controller appears at the bottom of the screen.

8. Click the red triangle in the upper left corner to open the parameter list.

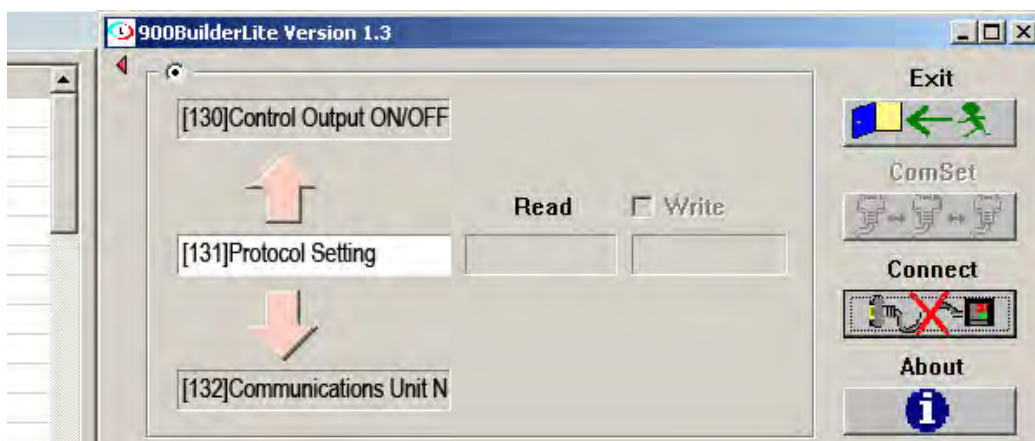


9. Scroll down to parameter [131] Protocol Setting.

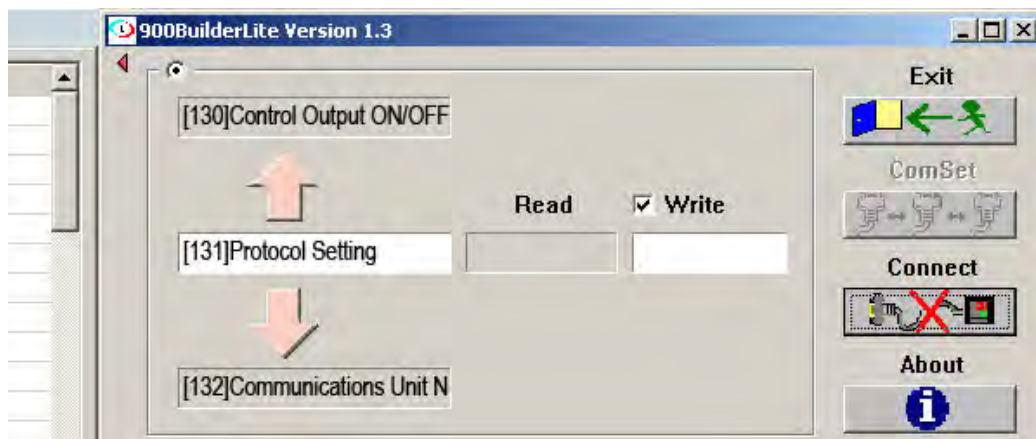


10. Double-click the parameter to edit it.

The parameter is now visible in the main dialog box.

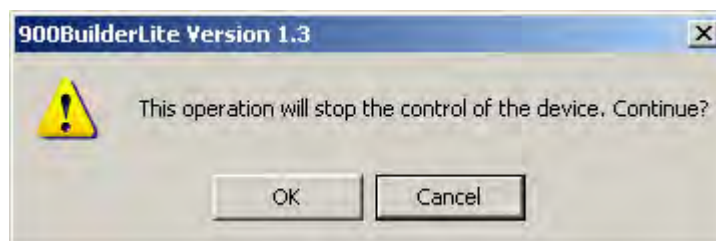


11. If it is not already selected, check Write.

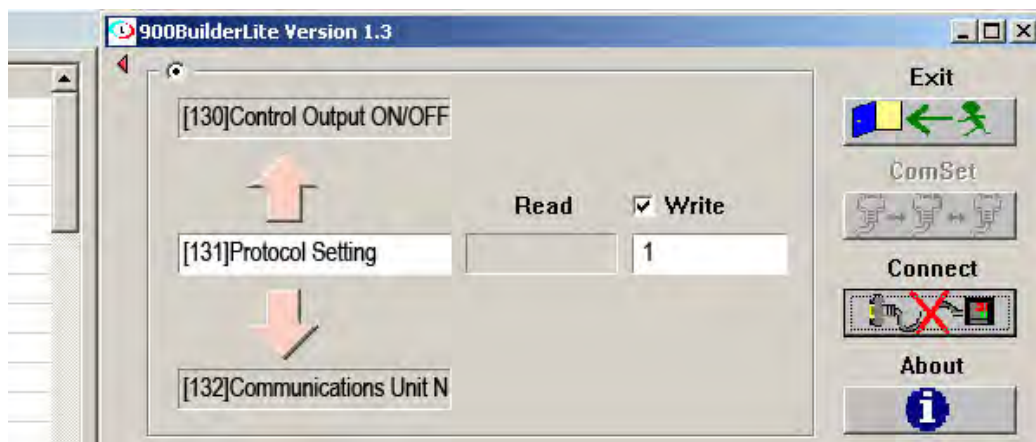


IMPORTANT

If the 900-TC temperature controller is in Run mode, an alert message appears each time you check Write.

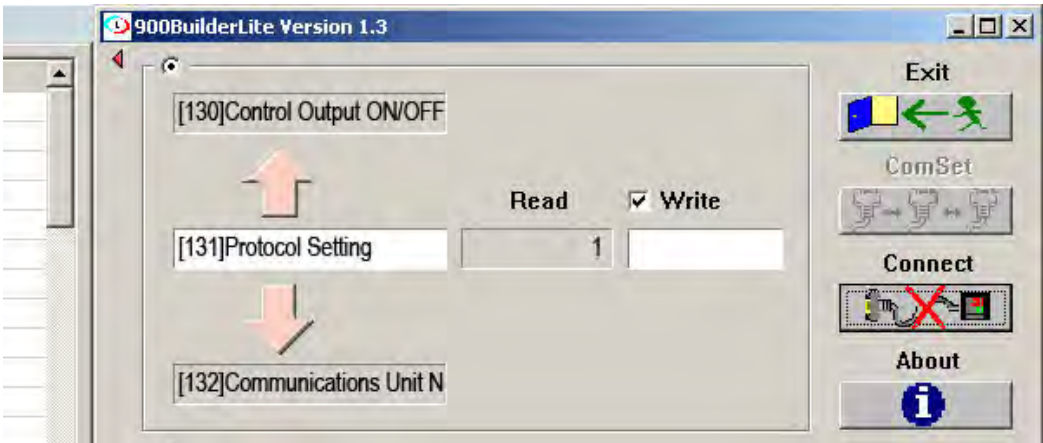


12. Type 1 for Modbus.

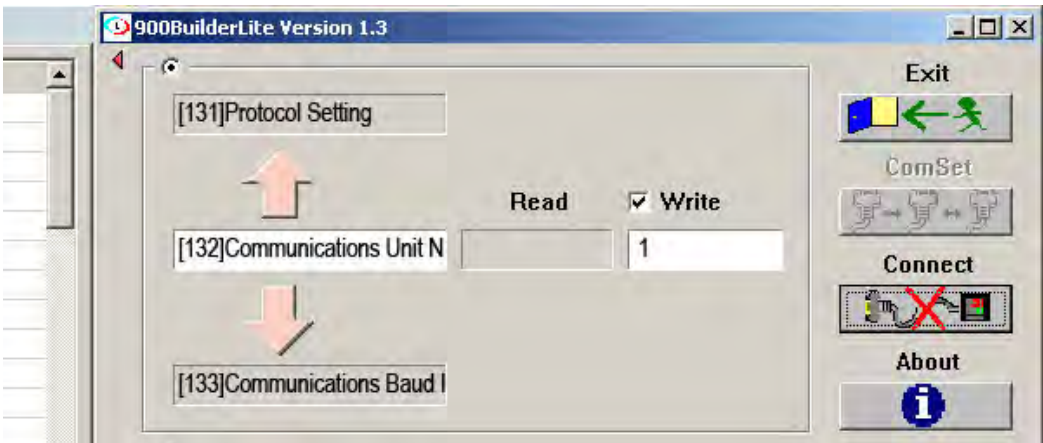


13. Press Enter on your personal computer keyboard.

The value appears in the Read field.



14. Use the Up and Down arrows on the main dialog box to access other communication parameters shown in the table below.



15. Repeat [step 11](#) and [step 12](#) to set the following communication parameters for your application.

The software does not list individual values but uses digits as shown in the table.

Parameter	Setting	
[131] Protocol Setting	1	MoD
[132] Communications Unit No.	1	Change to your specific node address. Node address 1 is the default setting.
[133] Communications Baud Rate	4	19.2 Kbps
[136] Communications Parity	0	None
[137] Send Data Wait Time	0...99	20 ms (default)

Proceed to the next section to set other parameters used in this application.

Set the Parameters Used in This Building Block Application

Change the following parameters for this application.

Parameter	Setting
[2] Set Point	80
[3] Alarm Value 1	75
[6] Alarm Value 2	85
[9] Alarm Value 3	0 ⁽¹⁾
[43] Input Type	7 = J type thermocouple
[47] Temperature Unit	1 = Fahrenheit

(1) Set this value to zero because the value is not used on the 900-TC16 temperature controller.

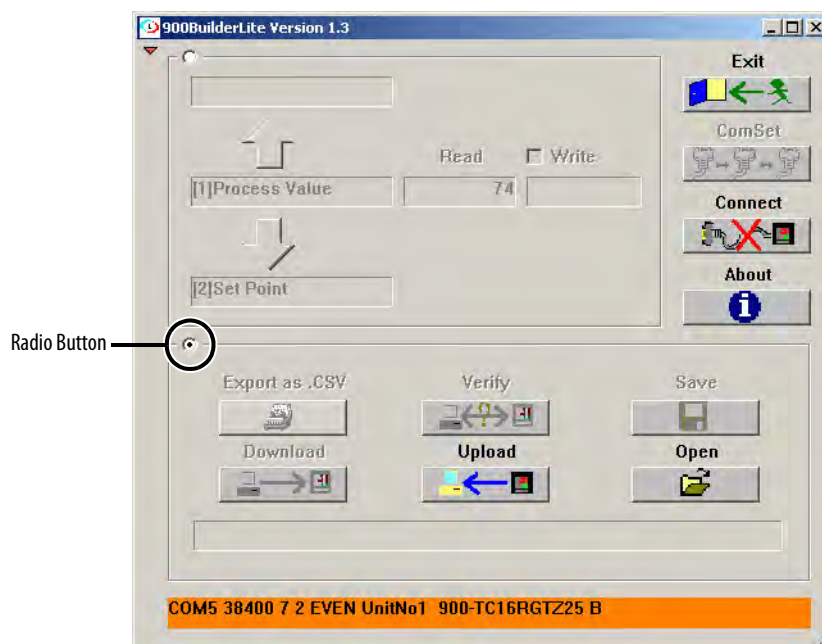
(2) Do not set this parameter to manual for On/Off control.

Parameter	Setting
[50] PID/OnOff	1 = PID
[56] Direct/reverse Operation	1 = Direct
[57] Alarm 1 Type	8 = absolute value, upper limit
[59] Alarm 2 Type	8 = absolute value, upper limit
[61] Alarm 3 Type	0 ⁽¹⁾
[105] Auto/Manual Select Addition	1 = Manual ⁽²⁾

Upload and Save Your Settings

Follow these steps to upload and save the settings made in the two previous sections. Once the program has been uploaded and saved, you can download it to other 900-TC temperature controllers.

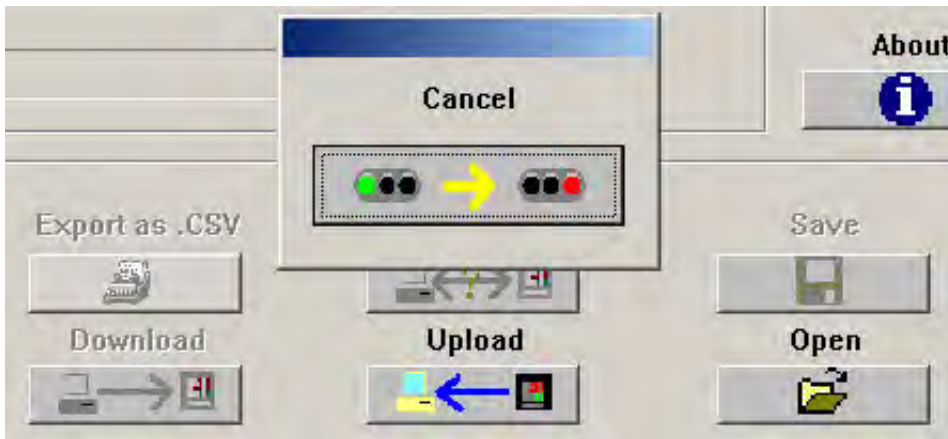
1. Click the radio button to activate the lower panel in the main dialog box.



2. Click Upload.



During the upload, a Cancel button appears (if you need to cancel the upload). It disappears when the upload is complete.



3. When the upload is complete, click Save.

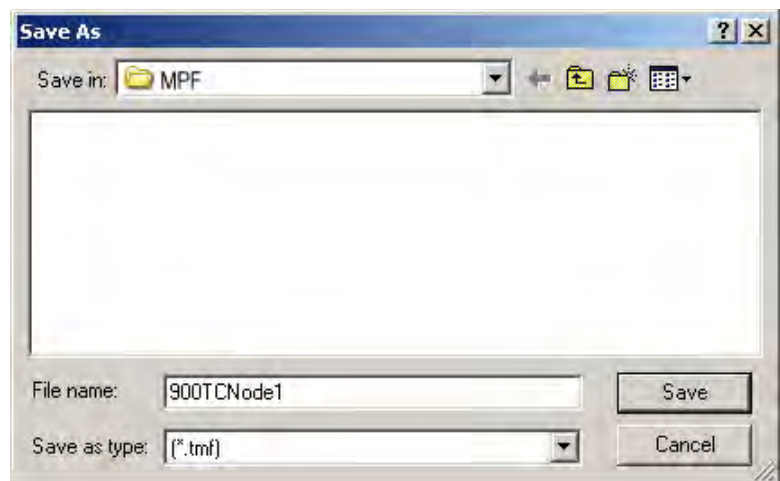


A dialog box appears for you to name and save the file.

4. Type a name for your project file.

900Builder Lite files use the TMF file extension.

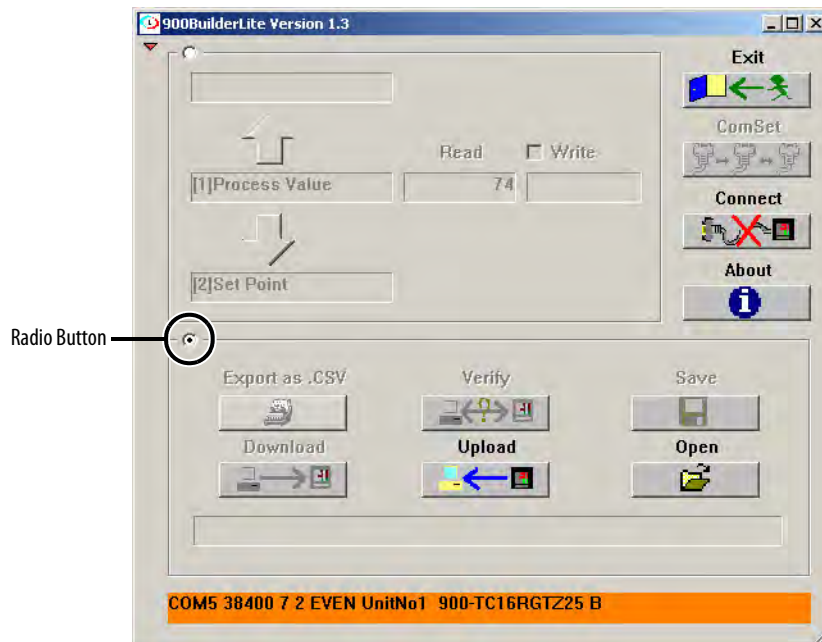
5. Select a folder on your personal computer in which to save the file.
6. Click Save to save the file and close the dialog box.



Download Your File to Another 900-TC Temperature Controller (optional)

Verify that the 900Builder Lite software, version 3.0, is configured and your personal computer is connected to the 900-TC temperature controller with the 900-CPOEM1 USB-serial conversion cable.

1. Click the radio button to activate the lower panel in the main dialog box of the 900Builder Lite software, version 3.0.



2. Click Open.



A new dialog box appears.

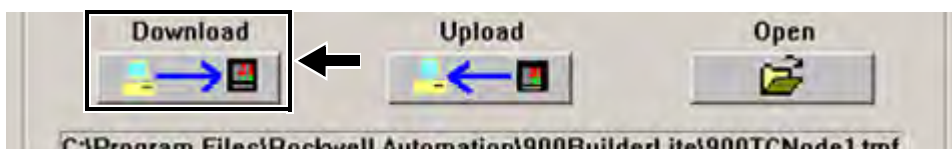
3. Locate your new project file (with the TMF extension) on your personal computer and click Open.

The chosen file name appears in the lower panel of the main dialog box.



TIP The file path shown above is only an example; your file path indicates that your file was saved in the location you choose on your personal computer.

4. Click Download.

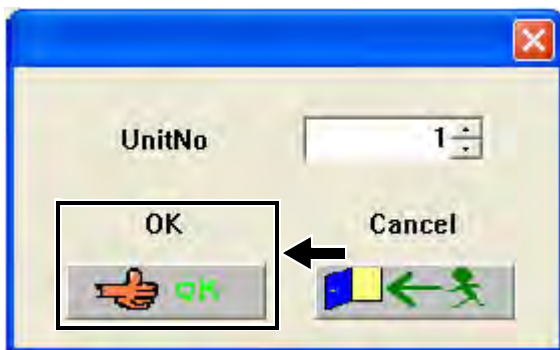


A new dialog box identifies the node address of the 900-TC temperature controller.

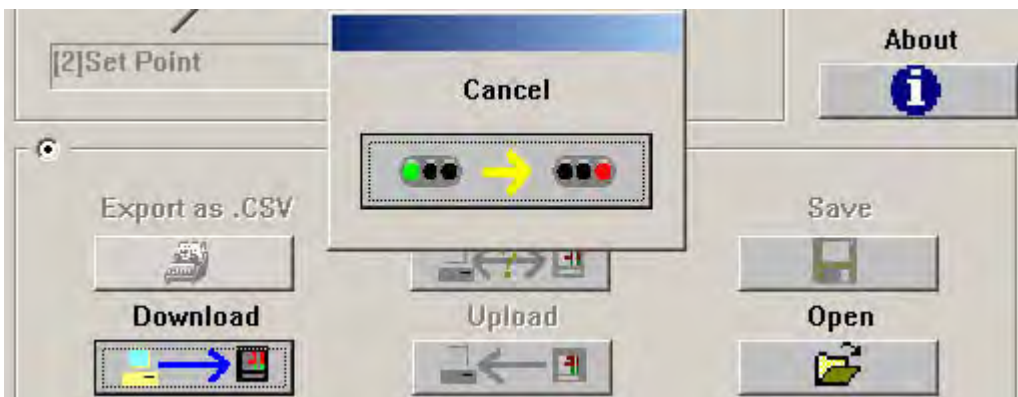


The number in the UnitNo field is 1 because it is the node address for the fixed, 4-pin connector on the 900-TC temperature controller to which the 900-CPOEM1 USB-Serial conversion cable is attached.

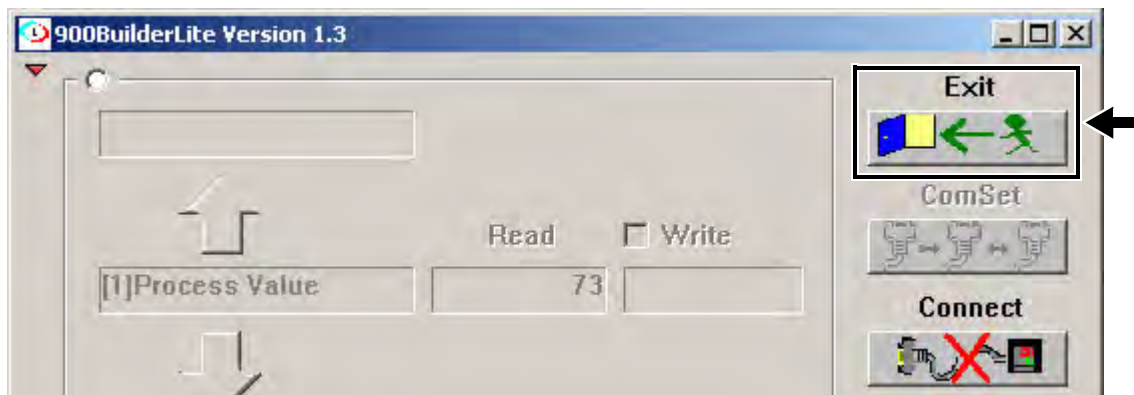
5. Click OK to initiate the file download from your personal computer and to close the dialog box.



During the download, a Cancel button appears (if you need to cancel the download). It disappears when the download is complete.



6. Click Exit.



The file has been successfully downloaded to another 900-TC temperature controller.

Review Other Possible Parameters

The following pages provide parameter flow diagrams to help you set other parameters specific to your application.

Figure 1 - Parameter Flow Diagram

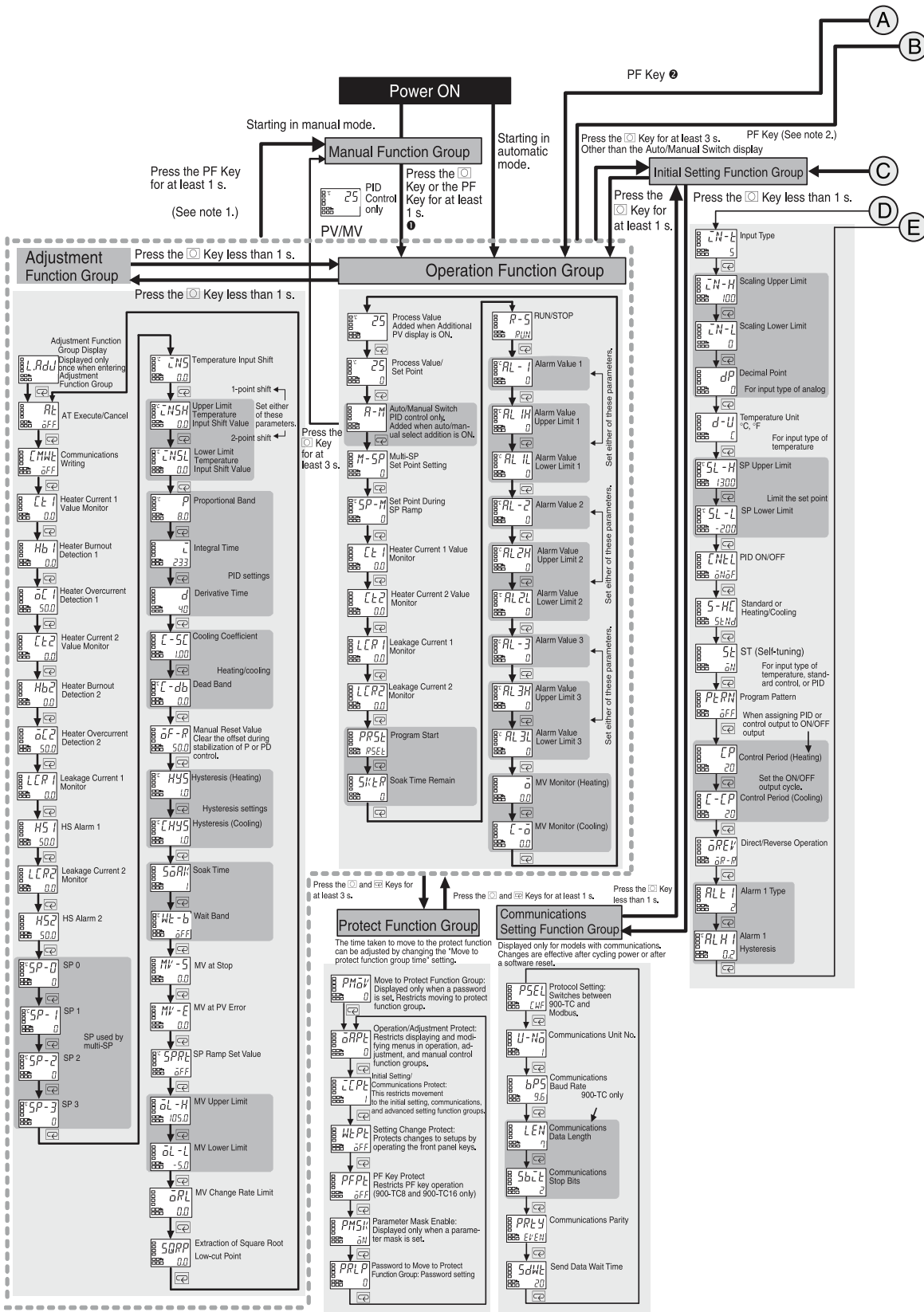
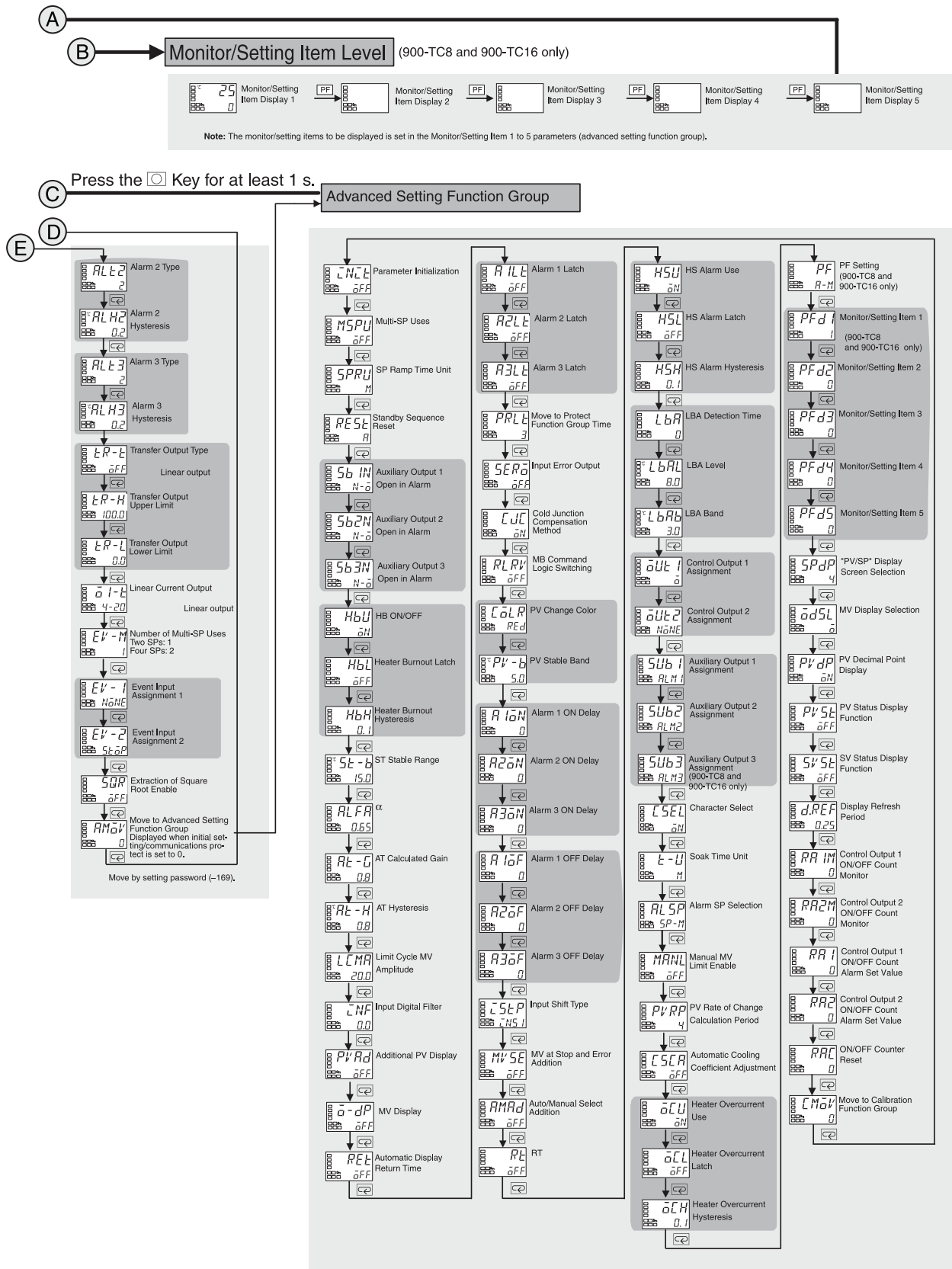


Figure 1 - Parameter Flow Diagram (continued)



Validate Your System

This chapter provides instructions on how to configure, connect, and validate communication between the devices in your 900-TC temperature control device building-block system.

Before You Begin

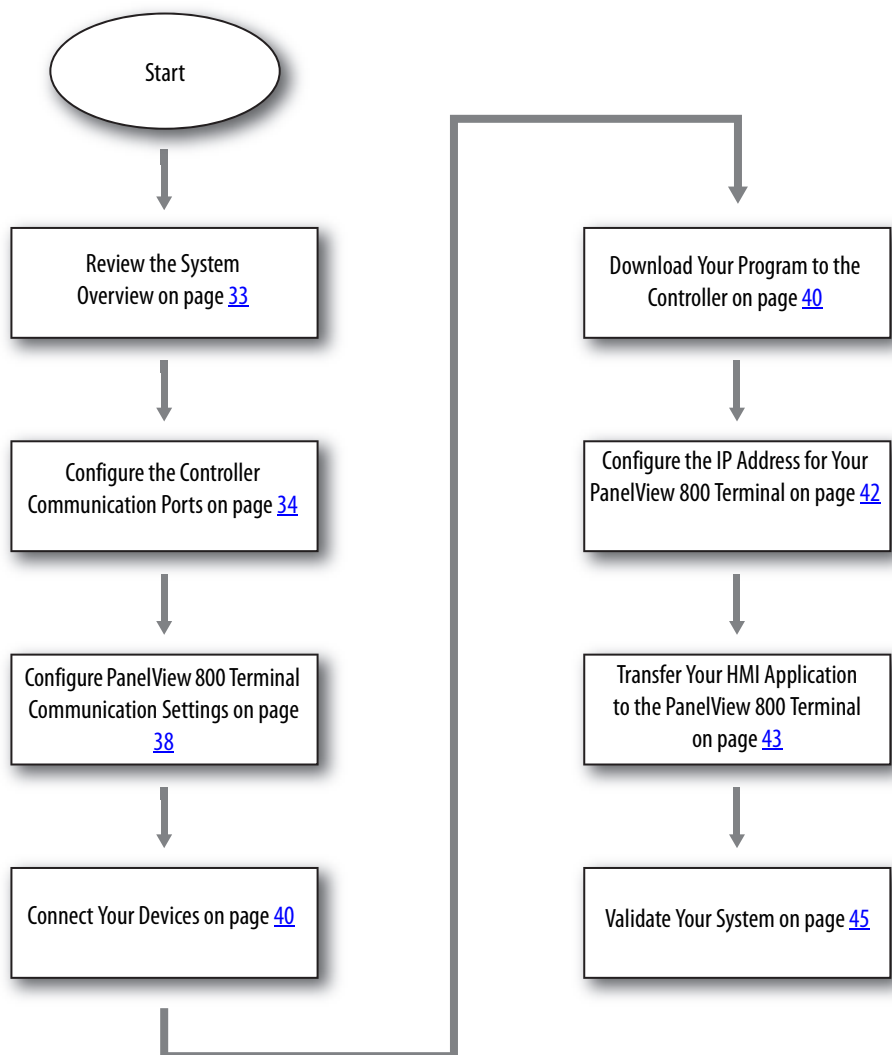
- Complete the steps in [Chapter 1](#).
- Verify that the devices are connected as shown in the assembled wiring diagrams.
- Verify that your Micro800 controller, the 900-TC Temperature Controller, and the PanelView 800 terminal have power applied to them.

What You Need

- Micro820, Micro830, or Micro850 controller with Isolated Serial Port plug-in module (catalog number 2080-SERIALISOL)
- 900-TC8 or 900-TC16 temperature controller
- 4 in. (or larger) PanelView 800 terminal
- 1761-CBL-PM02, 9-pin to 8-pin MINI-DIN RS-232 communication cable, if a CIP serial connection for the PanelView 800 terminal is used
- Two 1585J-M8xxx-2 RJ45 Ethernet patch cords, if a CIP on Ethernet connection for the PanelView 800 terminal is used
- 1783-USxxx Stratix 2000™ unmanaged Ethernet switch
- Two-wire, twisted-pair shielded RS-485 communication cable (Belden 3105A recommended)
- 900-TCxxxCOM card (one per 900-TC temperature controller)
- AK-U0-RJ45-TB2P, RJ45 two position terminal block with a 120Ω terminating resistor
- USB programming cable (A to B) or Ethernet cable for personal computer to Micro800 controller communication
- Personal computer with available USB port and Ethernet connection with Connected Components Workbench software, version 6 or later, installed

Follow These Steps

Complete these steps to validate your system.



Review the System Overview

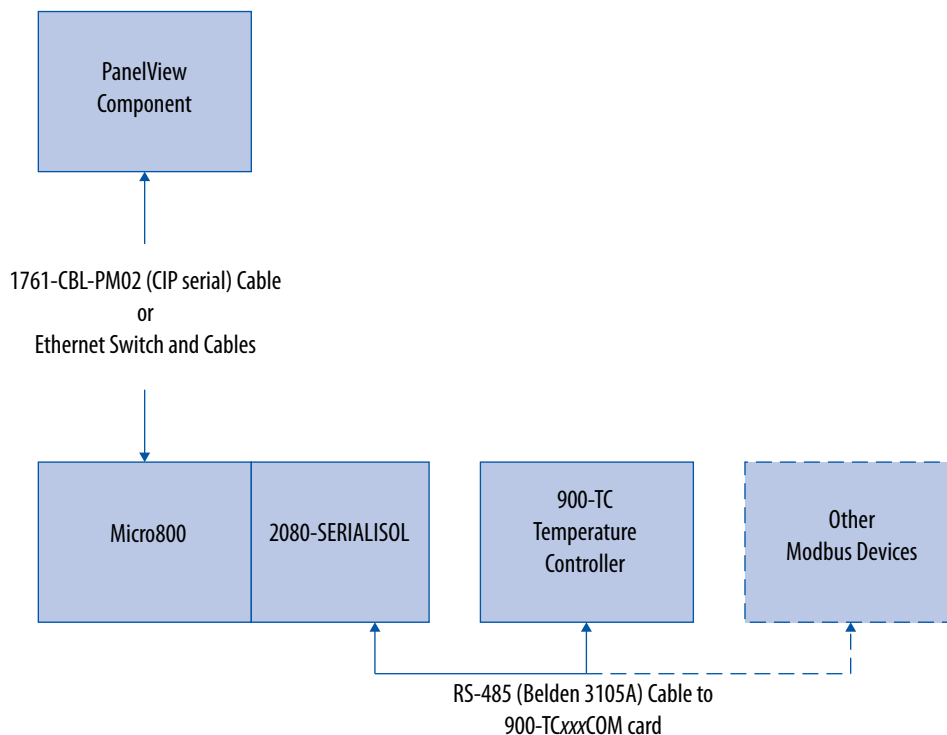
The PanelView 800 graphic terminal can be connected to the Micro800 controller with a CIP serial or CIP on Ethernet connection:

- When a CIP serial connection is used, connect the PanelView 800 terminal to the Micro800 controller's embedded serial port by using a 1761-CBL-PM02 cable.
- When a CIP on Ethernet connection is used, connect the PanelView 800 terminal to the Ethernet switch and connect the Ethernet switch to the Micro800 controller's embedded Ethernet port by using Ethernet patchcords.

Both methods of connection are explained in this manual, but choose only one method for your project.

The 900-TC temperature controller is connected to the Micro800 controller's Isolated Serial Port plug-in module (catalog number 2080-SERIALISOL) with two-wire, twisted-pair shielded cable (Belden 3105A recommended) and one 900-TC_{xxx}COM card per 900-TC temperature controller. These devices communicate with the Modbus RTU protocol (RS-485). The Micro800 controller is the Modbus master, and the 900-TC temperature controller is the Modbus slave. Additional Modbus RTU slave devices can be daisy-chained on this RS-485 network.

Figure 2 - Device and Network Layout Diagram



Configure the Controller Communication Ports

In the default project, the serial ports are already configured. The following settings are used for each serial port.

Table 1 - Default Serial Port Settings

Embedded Serial Port (to PanelView 800 terminal)	
Setting	Value
Driver	CIP Serial
Baud rate	38400
Parity	None
Unit address	1
Advanced Settings	
Error detection	CRC
Embedded responses	After One Received
Duplicate packet detection	Yes
Ack timeout (x 20 ms)	50
NAK retries	3
ENQ retries	3
Transmit retries	3
RTS off delay	0
RTS send delay	0
2080-SERIALISOL Plug-in Module (to 900-TC Temperature Controller)	
Setting	Value
Driver	Modbus RTU
Baud rate	19200
Parity	None
Modbus role	Modbus RTU Master
Advanced Settings	
Media	RS-485
Data bits	8
Stop bits	1
Response timer	200
Broadcast pause	200
Inter-Char timeout	0
RTS-Pre delay	0
RTS-Post delay	0

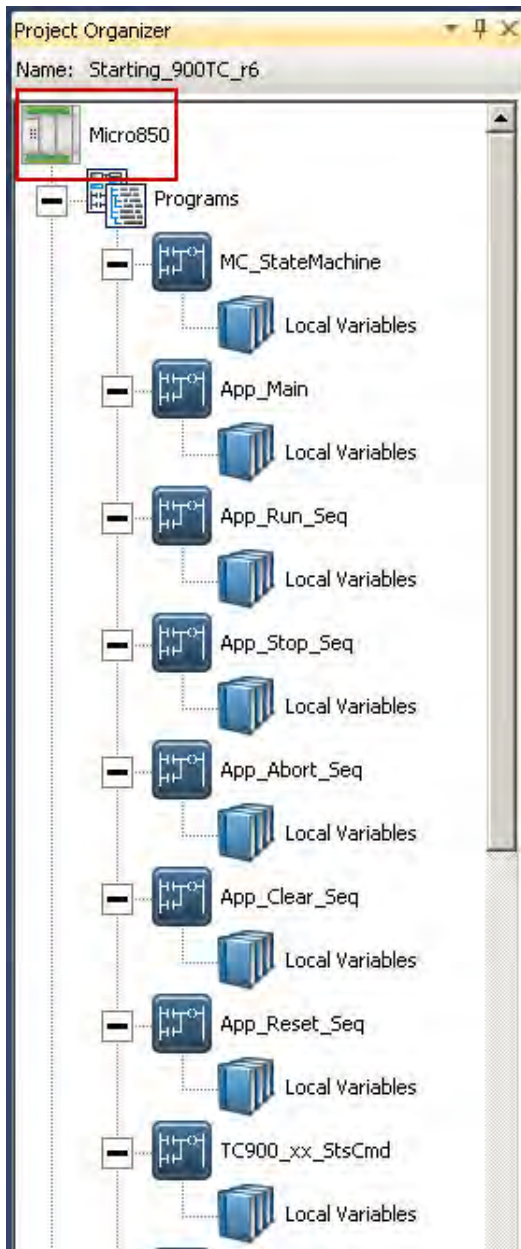
Follow these steps to modify these settings in the default Connected Components Workbench project.

1. From the Connected Components Workbench software, from the File menu, choose Open.
2. Choose the 'Starting_900TC-r6' project downloaded from the Sample Code website⁽¹⁾ or the CCAT version 2 generated project.

Use controller type change, if necessary, to match your Micro800 controller catalog number. Refer to the software help for instructions on using controller type change.

3. In the Project Organizer, double-click the controller icon.

This example shows a Micro850 controller.

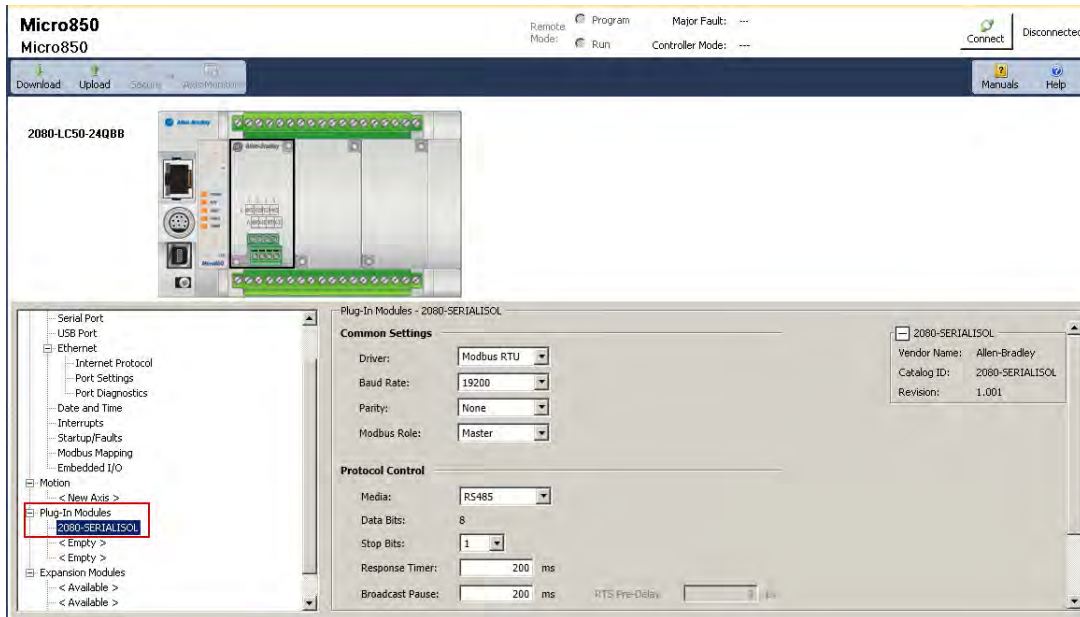


(1) http://samplecode.rockwellautomation.com/idc/groups/public/documents/webassets/sc_home_page.hcst

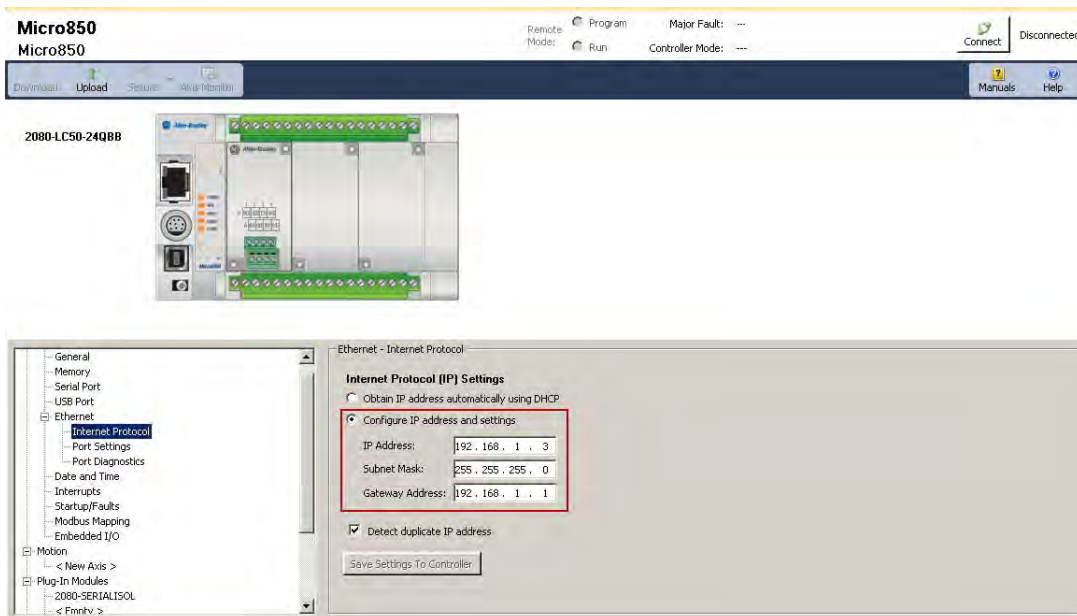
The Controller Detail view appears in the main project window.

4. Configure the settings for your PanelView 800 terminal communication port:

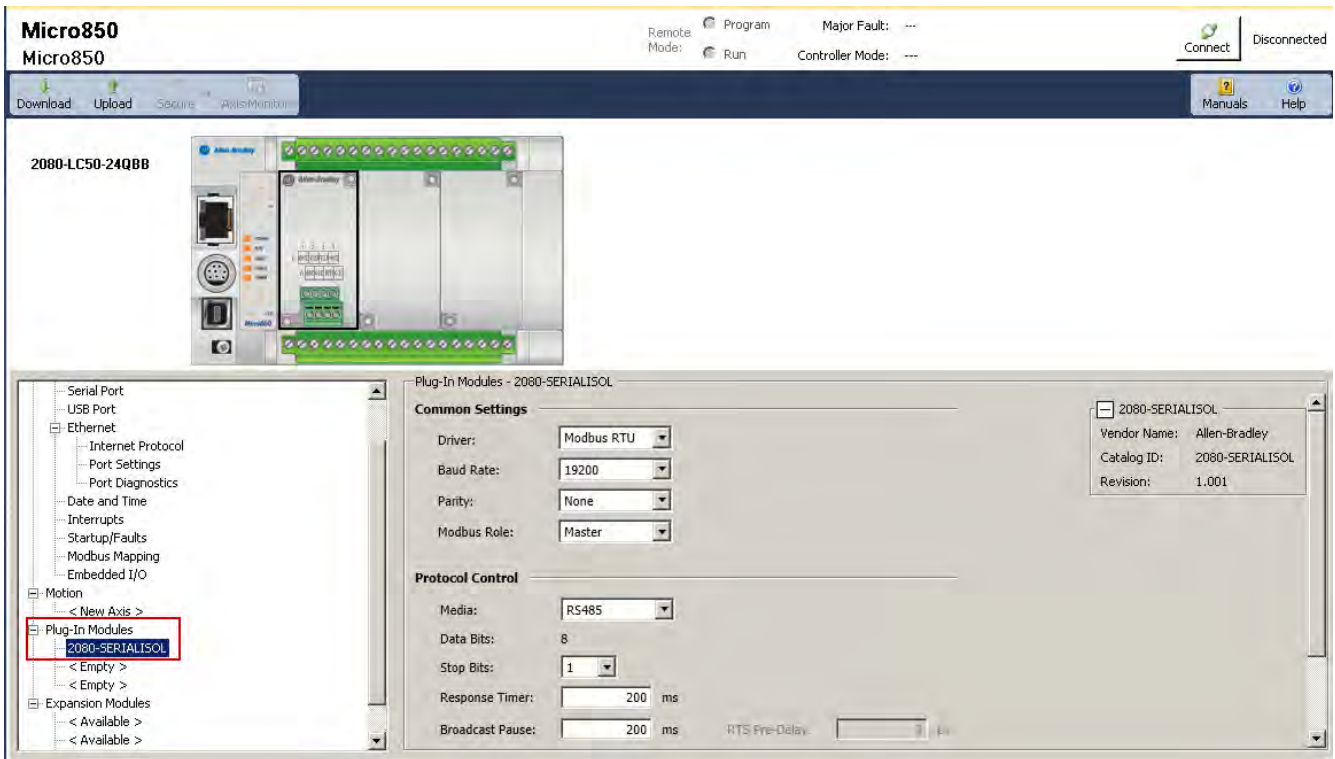
- If a CIP serial connection is used, select the embedded serial port in the controller configuration list and edit the required settings.



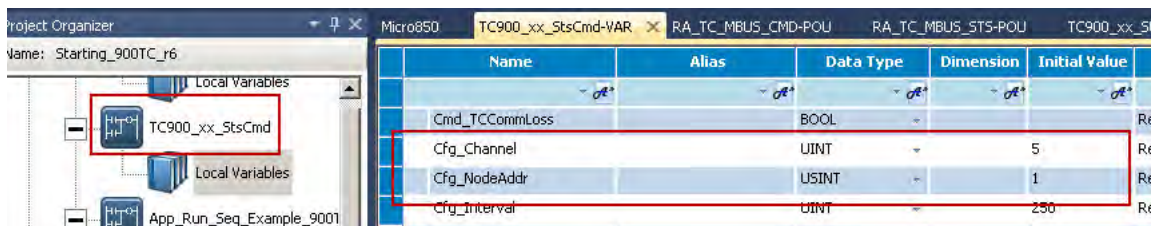
- If a CIP on Ethernet connection is used (Micro850 controller), complete the following steps.
 - a. In the controller configuration list, select the Ethernet port.
 - b. Click Configure IP address and settings.
 - c. Edit the IP Address, Subnet Mask, and Gateway Address settings.



- Expand Plug-in Modules in the controller configuration list, add (if not already present) and configure the 2080-SERIALISOL port for your controller in slot 1 as shown below.



- If your 900-TC temperature controller has a node address other than the default setting of 1, then you must set the Initial Value of the Local Variable named Cfg_NodeAddress in the program with a name that ends in '_StsCmd' to the node address value.
- If you installed the 2080-SERIALSOL in a plug-in slot other than 1, then you must set the Initial Value of the Local Variable named Cfg_Channel in the program with the name that ends in '_StsCmd' to the slot number plus 4.



Configure PanelView 800 Terminal Communication Settings

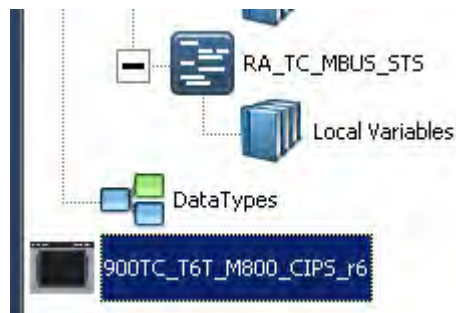
In the default project, the CIP serial communication and controller settings have already been configured. The following settings are used.

Table 2 - Default CIP Serial Communication and Controller Settings

Driver Configuration	
Protocol	CIP Serial
Port	RS-232
Baud rate	38400
Data format: 8-N-1	8-N-1
Flow control	None
Controller Settings	
Name	PLC-1
Controller type	Micro800
Address	1

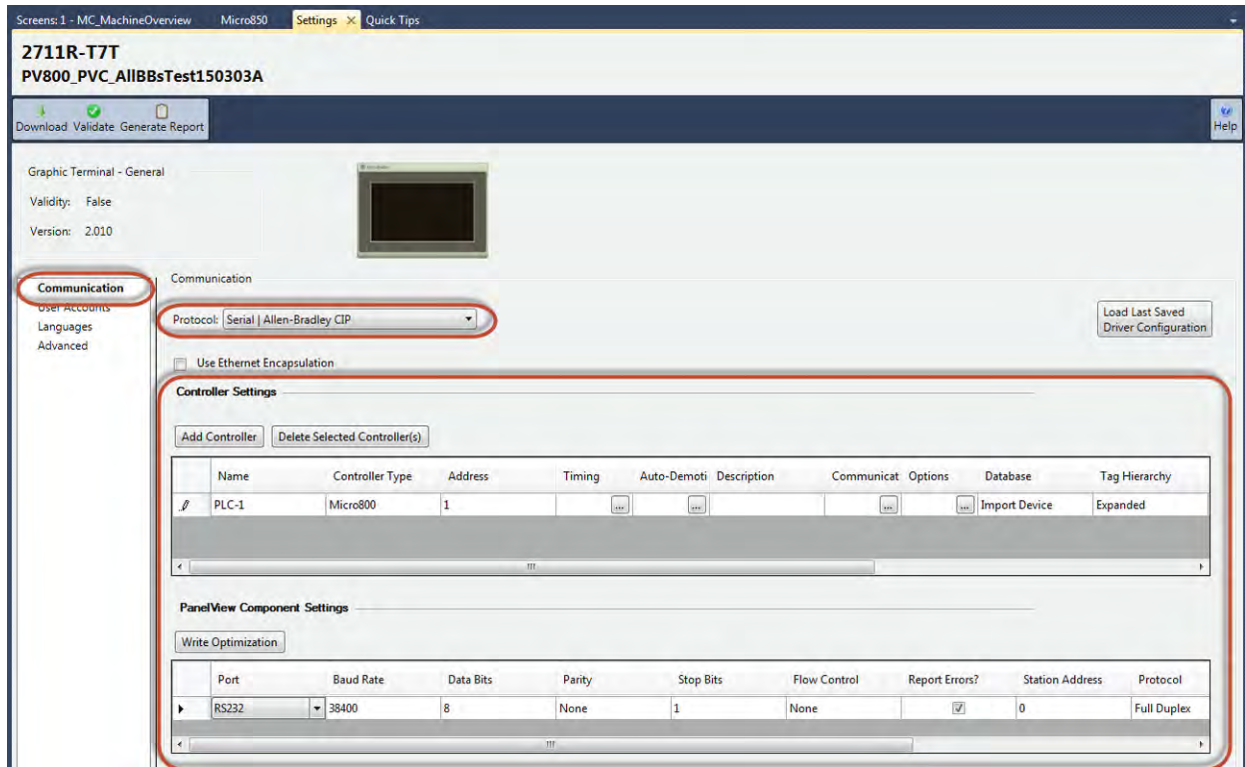
Follow these steps to modify these settings in the default Connected Components Workbench project.

1. In the Project Organizer, double-click the PanelView 800 device icon to open the PanelView 800 application editor.

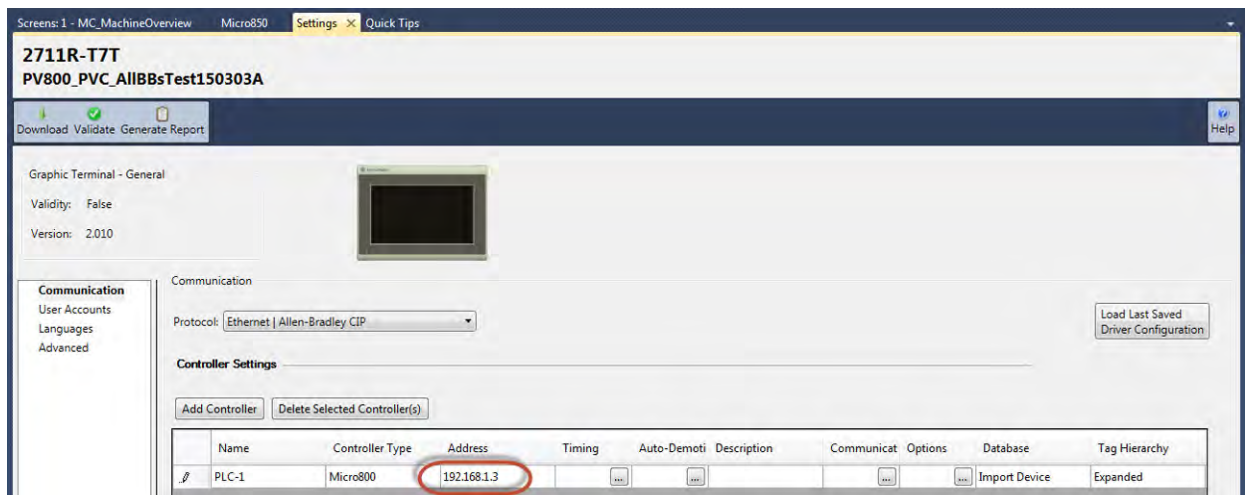


The PanelView 800 Communication Settings pane appears in the main project window.

2. Configure the appropriate communication settings:
 - For CIP Serial communication, configure the settings shown below.



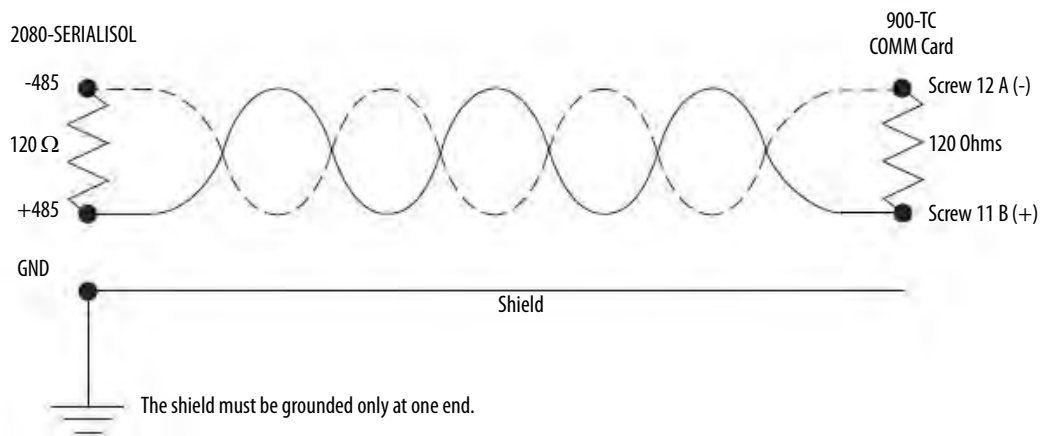
- For CIP on Ethernet communication, configure the settings shown below.



Connect Your Devices

Follow these steps to connect your devices.

1. Connect the PanelView 800 terminal to the Micro800 controller:
 - If a CIP serial connection is used, connect the PanelView 800 terminal serial RS-232 port to your Micro800 controller's embedded serial port by using a 1761-CBL-PM02 cable.
 - If a CIP on Ethernet connection is used, connect the PanelView 800 terminal Ethernet port to the Stratix switch and connect another Ethernet cable from the Stratix switch port to the Micro800 controller's embedded Ethernet port.
2. Connect the 900-TC Comm plug-in to your Micro800 controller's Isolated Serial Port (catalog number 2080-SERIALISOL) by using a two-wire, twisted-pair shielded cable (Belden 3105A, recommended).



Download Your Program to the Controller

Follow these steps to download your program to the controller.

1. Connect the computer to the controller by using either an Ethernet or USB connection.

If you are prompted to install any drivers, use the recommended drivers.

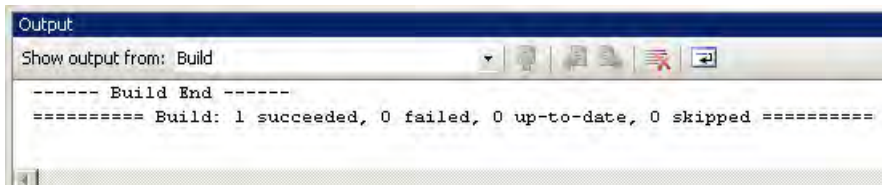


2. In your Connected Components Workbench project, in the Project Organizer, right-click your controller icon and choose Build.



3. If the build was successful, the Output pane at the bottom of your project window displays a success message. Or, if the build was unsuccessful, an error list appears.

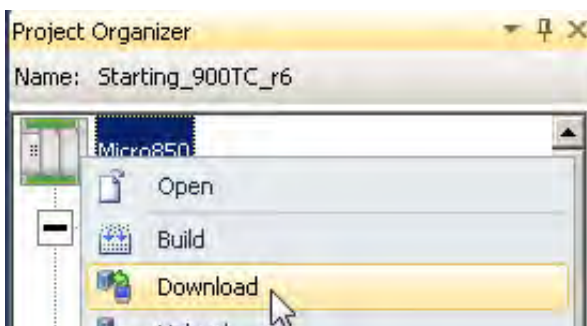
In this example, the Output pane shows that the build was successful.



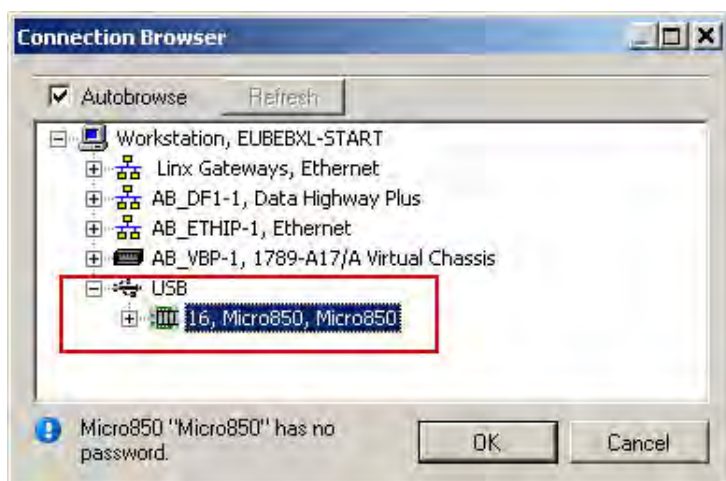
In this example, the Output pane shows that the build was not successful.



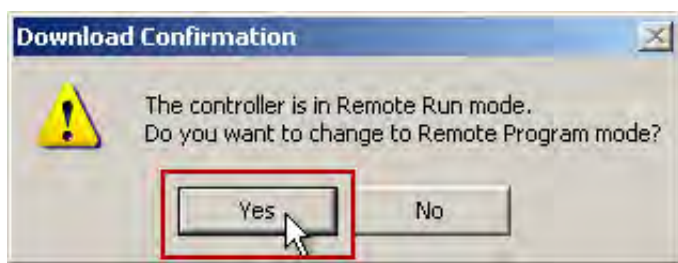
- a. If the build is successful, continue to [step 4](#).
 - b. Double-click an error description to go to that error.
 - c. Correct each error.
 - d. Repeat [step 2](#) and [step 3](#) until the build is successful and continue to [step 4](#).
4. From the Project Organizer, right-click your controller icon and choose Download.



5. From the Connection Browser, select your controller and click OK.



6. If prompted to change the controller mode to Remote Program mode, click Yes.



Configure the IP Address for Your PanelView 800 Terminal

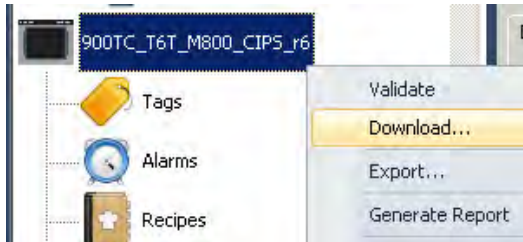
Follow these steps to configure a static IP address on the PanelView 800 terminal.

1. From the Main menu, press Communication to open the Communication screen.
2. Press Set Static IP Address.
3. Configure the IP Address and Mask values so they are in the same range as your Micro800 controller.
4. Press Main to return to the Main menu.

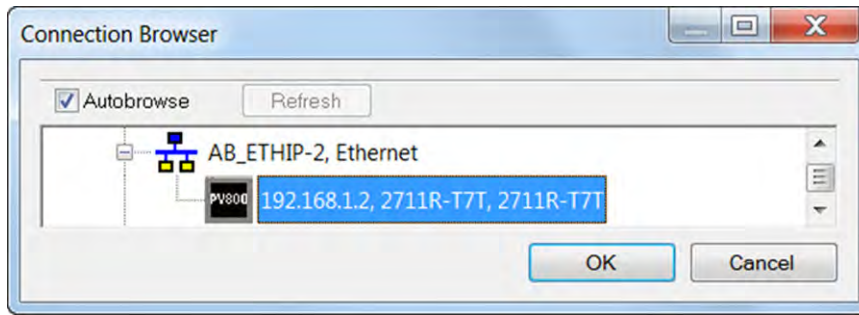
Transfer Your HMI Application to the PanelView 800 Terminal

Follow these steps to transfer your HMI application to the PanelView 800 terminal by using Connected Components Workbench software.

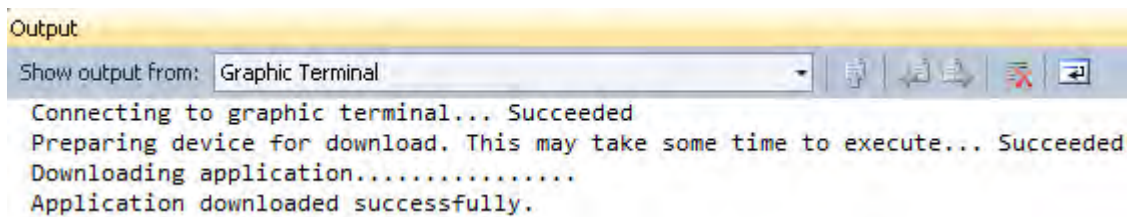
1. In the Project Organizer, right-click the PanelView 800 device icon and choose Download.



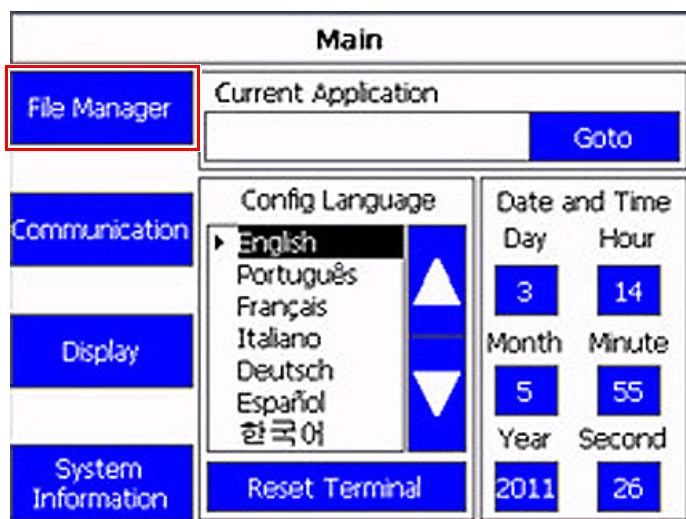
2. In the Connection Browser window, select the PanelView 800 terminal as your download destination.



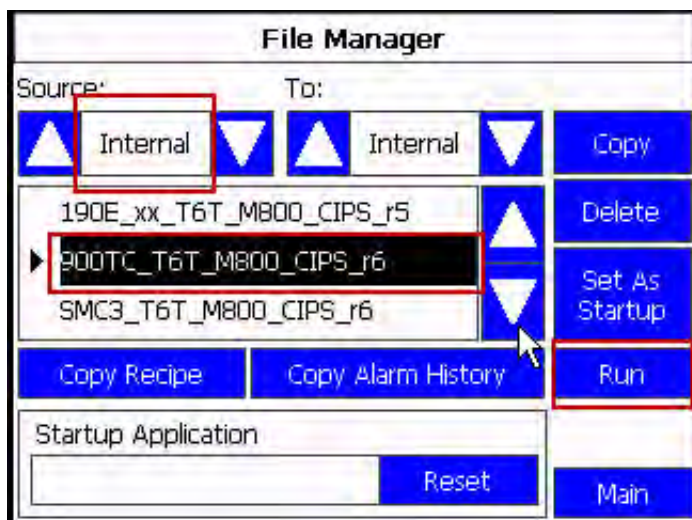
3. Click OK.
4. Verify that the download completed successfully.



- From the Main menu of your PanelView 800 terminal, press File Manager.



- On the File Manager screen, select Internal as your Source.
- Select your application.
- Press Run.



Validate Your System

In this section, you review the Machine Functions screen and explore the Status and Command screens to test the manual control of the building block.

Understand the Machine Functions Screen

The Machine Functions screen is the screen that links to all of the installed building blocks. When this screen is first loaded, you can complete the following tasks:

- Return to the Machine Overview screen by pressing the 'X' in the upper right corner of the screen.
- View a device in detail by pressing its button.
- View the current machine Auto/Manual state.
- Change the current machine Auto/Manual state.
- Clear machine faults, start/stop the machine (while in Auto mode) and go to the machine state diagram overview screen.



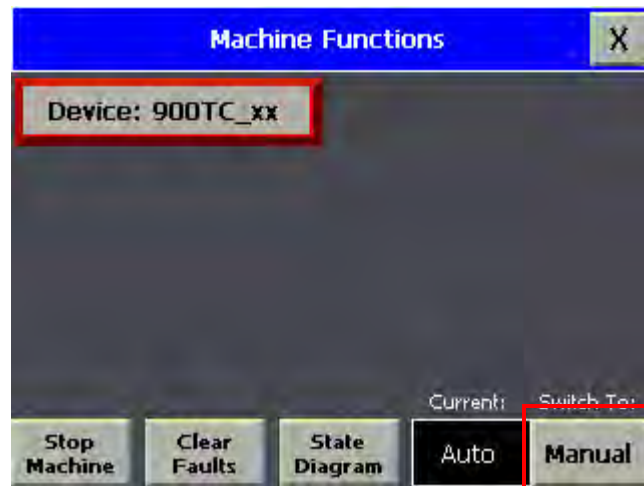
The border of the device button changes color to indicate a specific status. For the 900-TC temperature controller, the button border colors indicate the following status:

- A green border indicates the 900-TC temperature controller has the communication write command enabled.
- A gray border indicates the 900-TC temperature controller is inactive.
- A red border indicates the 900-TC temperature controller has a fault or an alarm present.

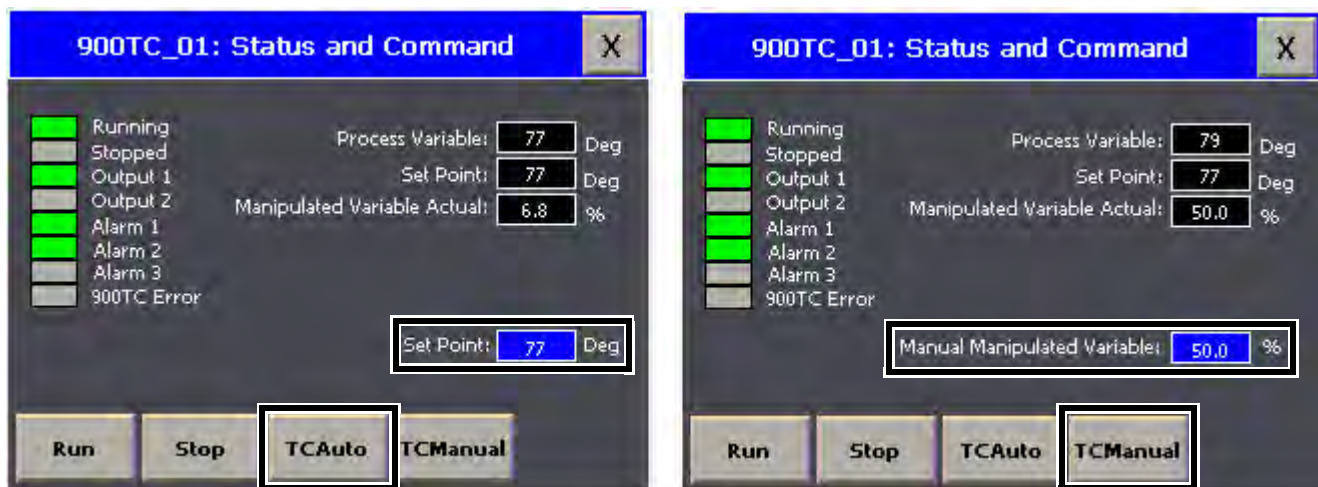
Understand the Status and Command Screen

The Status and Command screen provides 900-TC temperature controller status information and allows manual control of the temperature controller. Manual control is allowed only when the machine state is set to Manual.

1. From the Device Overview screen, switch the Operational mode to Manual.
2. Press the device.



In manual control, TCAuto lets you set the set point and TCManual lets you set the manipulated variable.



The following status and command indicators and fields appear on this screen.



Table 3 - 900-TC Temperature Controller Status Indicators

Status	Gray	Green	Red
Running	The controller is not in Run mode.	The controller is running.	—
Stopped	The controller is not in Stop mode.	The controller is stopped.	—
Output 1	Controller output 1 is OFF.	Controller output 1 is energized.	—
Output 2	Controller output 2 is OFF.	Controller output 2 is energized.	—
Alarm 1	Alarm 1 level has not been reached.	Alarm 1 level has been reached.	—
Alarm 2	Alarm 2 level has not been reached.	Alarm 2 level has been reached.	—
Alarm 3	Alarm 3 level has not been reached.	Alarm 3 level has been reached.	—
900TC Error	No other controller alarms or errors.	—	Controller error or other alarm is present

Table 4 - 900-TC Temperature Controller Status Data Fields

Status	Description
Process Variable	The temperature that is controlled or measured.
Set Point	The value configured on the process or temperature controller to control the system.
Manipulated Variable Actual	The final output percentage (0...100%) that is sent to a control element. For the temperature controller used in this building block, it is a 4...20 mA signal.

Table 5 - 900-TC Temperature Controller Command Buttons and Configurable Data Fields

Status	Description
Run	Press to put the controller in Run mode.
Stop	Press to stop the controller.
TCAuto	Press to put the controller in Auto mode so you can set the set point. IMPORTANT: Controller Auto mode is not the same as machine Auto mode.
TCManual	Press to put the controller in Manual mode so you can set the manipulated variable. IMPORTANT: Controller Manual mode is not the same as machine Manual mode.
Set Point	Set the controller set point.
Manual Manipulated Variable	Set the controller manipulated variable.
900TC Error(s)	Press to see the error name when the 900TC Error status indicator is illuminated red. IMPORTANT: The process variable value field is not accurate if 'Input Error' is the identified error.

If the Micro800 controller loses communication with a 900-TC temperature controller, then a 900-TC Communication Loss banner appears.



IMPORTANT Any controller status screen values during this condition are invalid because there is no communication with the 900-TC temperature controller to update the values.

Verify Manual Operation of the 900-TC Temperature Controller

In this section, you press each button on the 900-TC temperature controller status and command screen to verify manual operation.

IMPORTANT Before pressing and testing the buttons, verify that the following conditions are present:

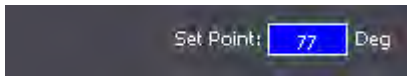
- Any heater or other device connected to the 900-TC temperature controller is in a safe state to operate manually.
- You have established a set point for your application.

1. Press Run.

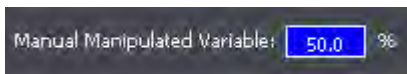
- Verify that the Running indicator status indicator is green.
- Verify that all Output and Alarm status indicators are green, depending on your process variable level and alarm level settings.



2. Press Stop.
3. Verify that the Stopped status indicator is green, and the Running and all Output status indicators are gray.
4. Press TCAuto.
5. Verify that the 'Set Point:' configurable data field is displayed.



6. Press TCManual.
7. Verify that the 'Manual Manipulated Variable:' configurable data field is displayed.



You have completed verifying the manual operation of your 900-TC temperature controller.

8. Press Run if you are ready to operate the 900-TC temperature controller.

Notes:

900-TC Temperature Controller User-defined Function Blocks

This appendix describes the available user-defined function blocks and their associated inputs and outputs.

RA_TC_MBUS_STS User-defined Function Block

This user-defined function block (UDFB) provides logic status and temperature information from a 900-TC temperature controller.

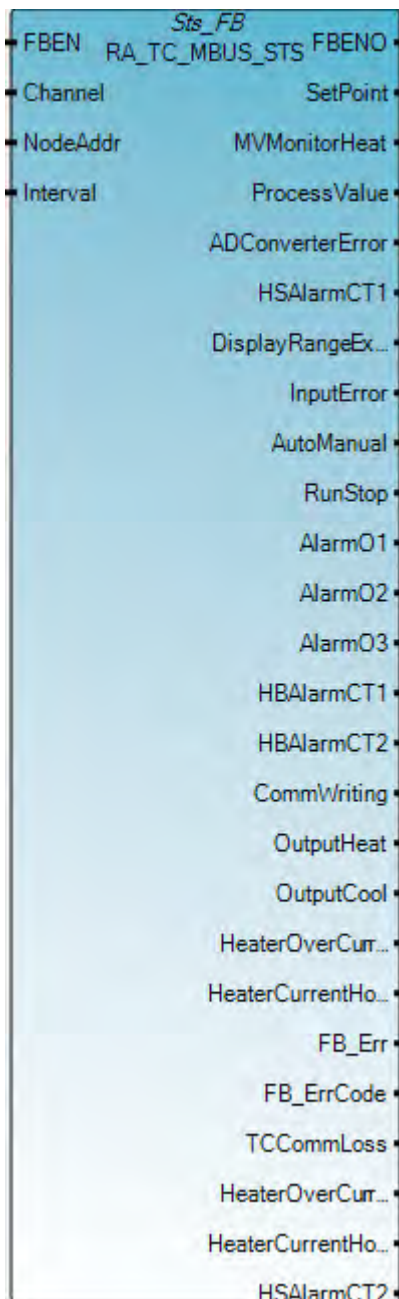
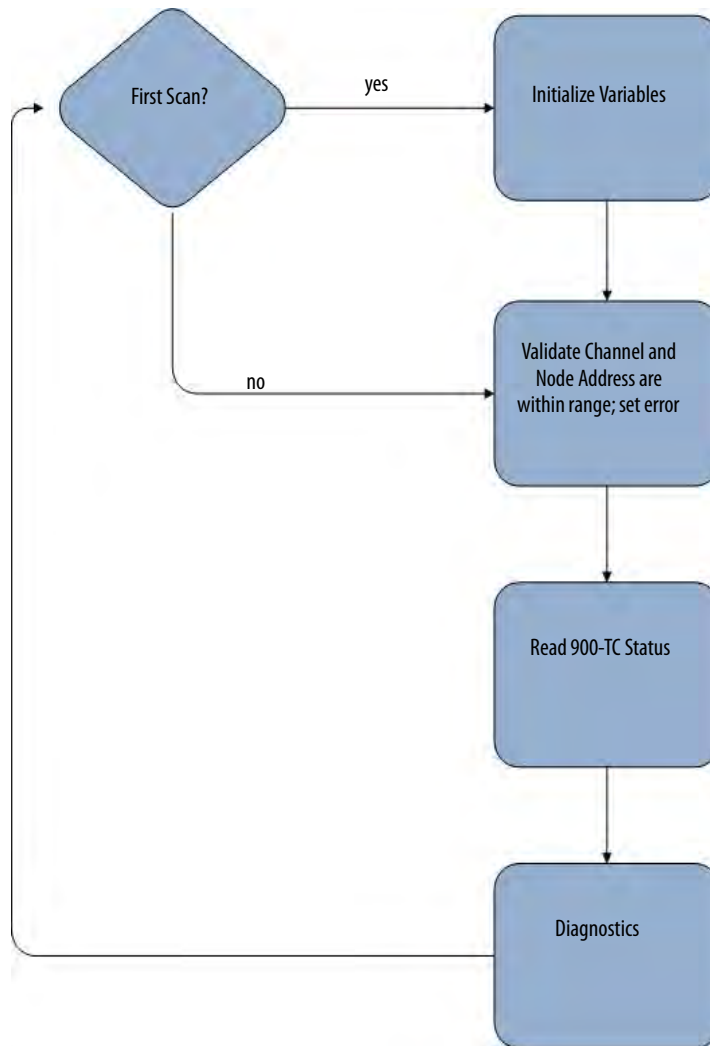


Table 6 - RA_900TC_MBUS_STS Inputs

Variable	Data Type	Description
FBEN	BOOL	Set this bit TRUE to enable the function block.
Channel	UINT	Set this value to the channel of the serial port to which the 900-TC temperature controller is communicating.
NodeAddress	USINT	Set this value to the Modbus node address of the 900-TC temperature controller.
Interval	UINT	Set this value to the rate in milliseconds, in which to update the 900-TC temperature controller's status variables.

Table 7 - RA_TC_MBUS_STS Outputs

Variable	Data Type	Description
FBENO	BOOL	This bit is TRUE when the function block is enabled.
FB_Err	BOOL	This bit is TRUE when an error in the function block occurs.
FB_ErrCode	UDINT	This value is the enumerated function block error code if an error occurs: <ul style="list-style-type: none"> • Bit 0 - Modbus Message Communications Error • Bit 1 - Invalid Channel • Bit 2 - Invalid Node Address
SetPoint	INT	This value enumerates the set point configured on the 900-TC temperature controller.
MVMonitorHeat	REAL	This value enumerates the manipulated value (0...100%) of the output.
ProcessValue	INT	This is the process variable that is controlled such as the temperature.
ADConverterError	BOOL	This bit is TRUE when there is an error in the 900-TC temperature controller's internal circuits.
HSAlarmCT1	BOOL	This bit is TRUE when the heater short alarm on CT1 is detected.
HSAlarmCT2	BOOL	This bit is TRUE when the heater short alarm on CT2 is detected.
DisplayRangeExceeded	BOOL	This bit is TRUE when the sensor input exceeds the display range (when the control range is larger than the display range).
InputError	BOOL	This bit is TRUE when the input value exceeds the control range, which is usually caused by the wrong RTD or thermocouple type.
AutoManual	BOOL	This bit is TRUE when the 900-TC temperature controller is in Manual mode.
RunStop	BOOL	This bit is TRUE when the 900-TC temperature controller is in Stop mode.
Alarm01	BOOL	This bit is TRUE when the 900-TC temperature controller's alarm output 1 has reached set level.
Alarm02	BOOL	This bit is TRUE when the 900-TC temperature controller's alarm output 2 has reached set level.
Alarm03	BOOL	This bit is TRUE when the 900-TC temperature controller's alarm output 3 has reached set level.
HBAAlarmCT1	BOOL	This bit is TRUE when the 900-TC temperature controller's burnout alarm on CT1 is detected.
HBAAlarmCT2	BOOL	This bit is TRUE when the 900-TC temperature controller's burnout alarm on CT2 is detected.
CommWriting	BOOL	This bit is TRUE when the 900-TC temperature controller's communication writing is enabled.
OutputHeat	BOOL	This bit is TRUE when the 900-TC temperature controller's output 1 is enabled.
OutputCool	BOOL	This bit is TRUE when the 900-TC temperature controller's output 2 is enabled.
HeaterOverCurrentCT1	BOOL	This bit is TRUE when the heater over current on CT1 is detected.
HeaterOverCurrentCT2	BOOL	This bit is TRUE when the heater over current on CT2 is detected.
TCCommLoss	BOOL	This bit is TRUE when communication is lost between the controller and the 900-TC temperature controller.

Figure 3 - RA_TC_MBUS_STS UDFB Flowchart

RA_TC_MBUS_CMD UDFB

This UDFB provides basic logic control and temperature command of a 900-TC temperature controller.

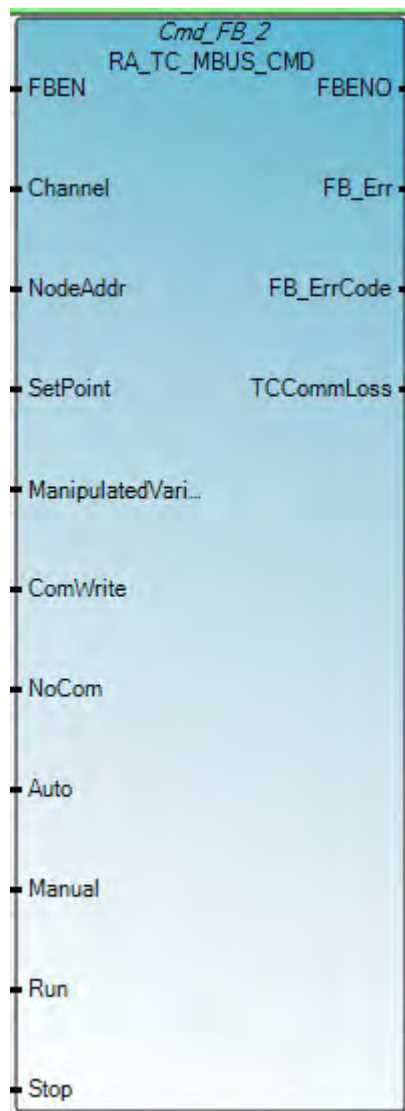


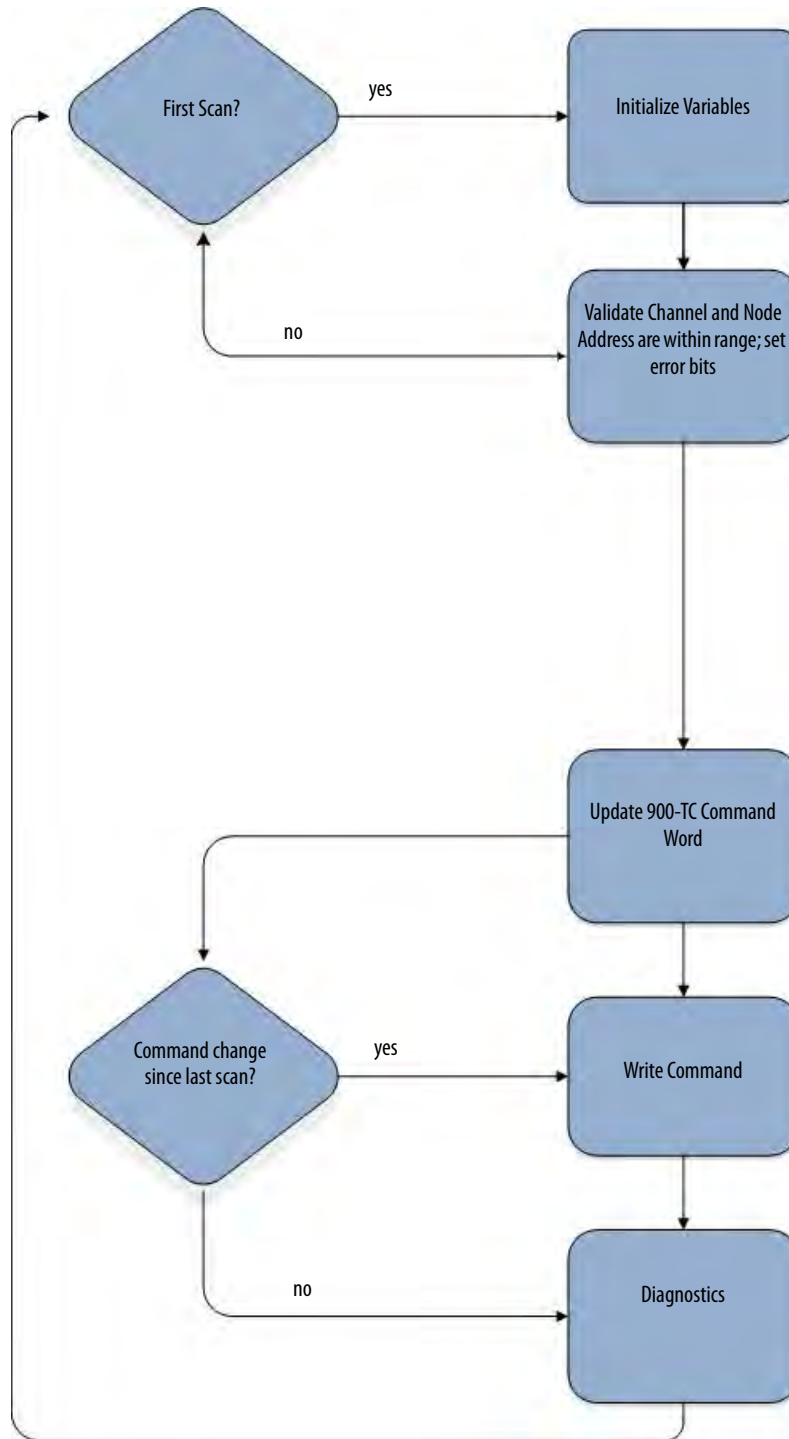
Table 8 - RA_TC_MBUS_CMD Inputs

Variable	Data Type	Description
FBEN	BOOL	Set this bit TRUE to enable the function block.
Channel	UINT	Set this value to the channel of the serial port to which the 900-TC temperature controller is communicating.
NodeAddress	USINT	Set this value to the Modbus node address of the 900-TC temperature controller.
SetPoint	INT	In the Auto mode, set the set point value on the 900-TC temperature controller.
ManipulatedVariable	REAL	In the Manual mode, set the manipulated variable for the output of the 900-TC temperature controller.
ComWrite	BOOL	Set this bit TRUE to enable communication writing.
NoCom	BOOL	Set this bit TRUE to disable communication writing.
Auto	BOOL	Set this bit TRUE to enable Auto mode on the 900-TC temperature controller.
Manual	BOOL	Set this bit TRUE to enable Manual mode on the 900-TC temperature controller.
Run	BOOL	Set this bit TRUE to enable the 900-TC temperature controller to run.
Stop	BOOL	Set this bit TRUE to stop the 900-TC temperature controller. IMPORTANT: Stop mode does not work in Manual mode.

Table 9 - RA_TC_MBUS_CMD Outputs

Variable	Data Type	Description
FBENO	BOOL	This bit is TRUE when the function block is enabled.
FB_Err	BOOL	This bit is TRUE when an error in the function block occurs.
FB_ErrCode	UDINT	This value is the enumerated function block error code if an error occurs: <ul style="list-style-type: none"> • Bit 0 - Modbus Message Communications Error • Bit 1 - Invalid Channel • Bit 2 - Invalid Node Address

Figure 4 - RA_TC_MBUS_CMD UDFB Flowchart



Global Variables

This appendix contains the global variables used for user program interfacing.

Table 10 - Global Variables

Variable Name	Variable Description
(user-defined prefix)_Cmd_Stop_Auto	Stop the 900-TC temperature controller
(user-defined prefix)_Cmd_Run_Auto	Run the 900-TC temperature controller
(user-defined prefix)_Cmd_Set_Point_Auto	Set Point in TC Auto mode
(user-defined prefix)_Cmd_ManipulatedVariable_Auto	Manipulated variable in TC Manual mode
(user-defined prefix)_Cmd_TCAuto_Auto	Set the 900-TC temperature controller to Auto mode via machine
(user-defined prefix)_Cmd_TCManual_Auto	Set the 900-TC temperature controller to Manual mode via Machine
(user-defined prefix)_Cmd_CommWrite	Enables 900-TC temperature controller communication writing
(user-defined prefix)_Cmd_NoComm	Disable 900-TC temperature controller communication writing
(user-defined prefix)_Sts_900TC_Error	The 900-TC temperature controller has an error or alarm
(user-defined prefix)_Sts_ADConvertor	A/D Convertor Error
(user-defined prefix)_Sts_Alarm_1	Alarm 1 level achieved
(user-defined prefix)_Sts_Alarm_2	Alarm 2 level achieved
(user-defined prefix)_Sts_Alarm_3	Alarm 3 level achieved
(user-defined prefix)_Sts_Auto	Auto mode
(user-defined prefix)_Sts_AutoManual	TRUE when the 900-TC temperature controller is in Manual mode
(user-defined prefix)_Sts_CommunicationWriting	Communication Writing enabled
(user-defined prefix)_Sts_DisplayRangeExceeded	Sensor input exceeds the display range
(user-defined prefix)_Sts_HBAAlarm1	Heater Burnout Alarm 1
(user-defined prefix)_Sts_HBAAlarm2	Heater Burnout Alarm 2
(user-defined prefix)_Sts_HeaterCurrentHoldCT1	Heater Current Hold CT1
(user-defined prefix)_Sts_HeaterCurrentHoldCT2	Heater Current Hold CT2
(user-defined prefix)_Sts_HeaterOverCurrentCT1	Heater Over Current CT1
(user-defined prefix)_Sts_HeaterOverCurrentCT2	Heater Over Current CT2
(user-defined prefix)_Sts_HSAAlarmCT1	Heater Short Alarm on CT1
(user-defined prefix)_Sts_HSAAlarmCT2	Heater Short Alarm on CT2
(user-defined prefix)_Sts_InputError	Input value exceeds the control range
(user-defined prefix)_Sts_ManipulatedVariable	Enumerated manipulated value 0 - 100% of the output
(user-defined prefix)_Sts_Output_1	Output 1
(user-defined prefix)_Sts_Output_2	Output 2
(user-defined prefix)_Sts_Process_Variable	Process variable that is controlled, such as temperature
(user-defined prefix)_Sts_Run	900TC temperature controller run

Table 10 - Global Variables

Variable Name	Variable Description
(user-defined prefix)_Sts_RunStop	TRUE when the 900-TC temperature controller is in Stop mode
(user-defined prefix)_Sts_Set_Point	Set Point configured on the 900-TC temperature controller
(user-defined prefix)_Sts_TCommLoss	Communication is lost between the Micro800 controller and the 900-TC temperature controller

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